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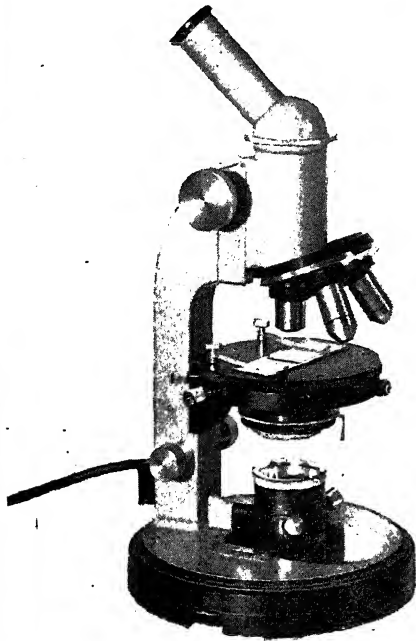
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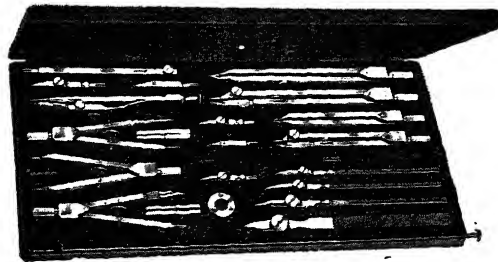
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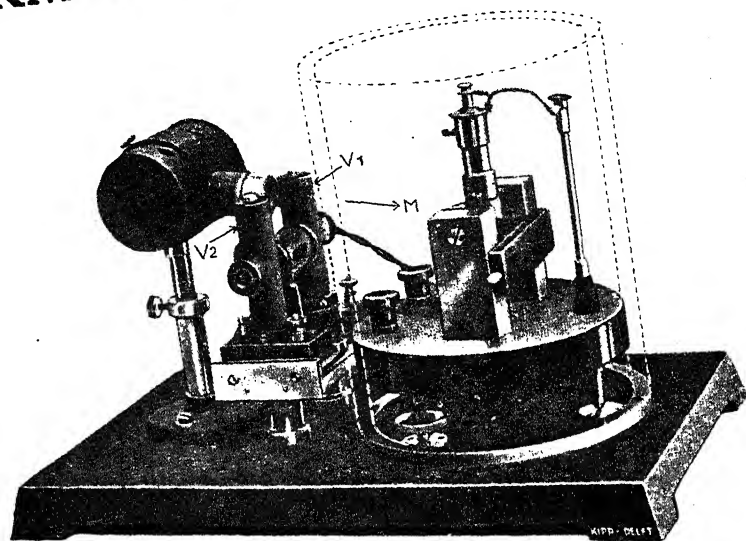
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THE INDIAN SCIENCE CONGRESS, POONA, 1950

THE Indian Science Congress held its thirty-seventh session early this month in the ancient and historic city of Poona, the cultural centre of Maharashtra, rich in traditions for unostentatious and dignified scholarship, deep erudition and solid achievement shy of cheap showmanship. To-day, Poona represents one of the largest educational and research centres in India, and the session naturally attracted a record number of delegates (over 5,000) from all over India. A distinguishing feature of the Congress was the presence of the overseas delegates from England, France, Sweden, Russia and the U.S.A. The Department of Scientific and Industrial Research of the Government of India, which is guided by Sir S. S. Bhatnagar, has been responsible for this salutary innovation which has served to establish international contacts, promote goodwill and understanding,

and stimulate and enliven the scientific atmosphere of the Congress. The visiting scientists included Sir Robert Robinson, President of the Royal Society, who was accompanied by Lady Robinson, Professor A. H. Compton, the eminent Nuclear Physicist of the U.S.A., Dr. H. Mark of the Brooklyn Polytechnic Institute, Dr. E. U. Condon, Director of the Bureau of Standards, U.S.A., Professor Frederic Joliot and Dr. Irene Joliot Curie, the famed physicists of France, Dr. Desmond Bernal, familiar to all the scientific workers the world over, Professor Rydbeck of Sweden and others.

Dr. M. R. Jayakar, the Vice-Chancellor of the University of Poona, extended a cordial welcome to the delegates of the Congress.

In conformity with traditional practice, Raja Maharaj, Governor of Bombay, inaugurated the Session. In the course of his opening speech, His Excellency declared, "The history of the

world and of human progress has been a continuous and ever-increasing conquest of nature and the harnessing of natural processes, through the medium of scientific knowledge and equipment, to ameliorate the conditions of existence and to lead us to richer and fuller lives. The economic and material development of the world is largely dependent on science. Basic, applied and utilitarian research is of immeasurable value for the realisation of the latent potentialities of every country."

Prime Minister Nehru, addressing the plenary session of the Congress, reiterated his unshakable faith in the potential ability and resourcefulness of Science and Technology in solving the economic and sociological problems confronting the Nation. Panditji felt convinced that "until our approach is more and more that of the scientist and the engineer, we shall not be able to understand, much less solve, these problems, even though we might have the highest type of scholars in other fields". He declared that "the problems are to be tackled with the *spirit of a man who does things himself and not sit in the office ordering people about*" (Italics ours). He wanted them to give "not vague advices worthy of con-

sideration" but practical help in the solution of the country's problems. He urged men and women of science to inculcate a spirit of international outlook in the minds of India's youth who are destined to inherit the administrative burden of the future. He stressed the imperative necessity of full co-operation between the politician and the scientist, which, he added, was not easy to secure. Paying a tribute to the visiting scientists, Pandit Nehru appealed to them that they "should not merely confine themselves to aid the deliberations of the Conference, but also talk to our youth and make them feel the international quality of Science."

The Poona session will remain a land mark in the progress of science in India because of the eventful opening of the National Chemical Laboratories by Prime Minister Pandit Nehru before a distinguished gathering. This is the first of the eleven National laboratories brought into existence by the organising genius of Sir S. S. Bhatnagar under the inspiring patronage of an enlightened National Government. They constitute a practical expression of the keen and abiding interest taken by Pandit Nehru and his Government in advancing the cause of science and technology in this country.

THE SIXTEENTH CONFERENCE OF THE INDIAN MATHEMATICAL SOCIETY

THE Sixteenth Conference of the Indian Mathematical Society was held at the Senate House, Madras, from 26th to 28th December, 1949. Besides the members and delegates to the conference, Prof. M. H. Stone of Chicago, Prof. Herman Wold of Sweden, and Prof. O. G. Tietjens of the Aeronautical Department of the Indian Institute of Science, Bangalore, participated in the conference. The Vice-Chancellor of the Madras University, Dr. A. Lakshmanaswami Mudaliar, in welcoming the members and delegates, referred to the late S. Ramanujan's mathematical achievements and the encouragement given to him by the Madras University. Sir C. V. Raman inaugurated the conference. The President-elect, Dr. A. Narasinga Rao, in his presidential address, outlined the place of mathematics in the evolution of the human mind and of science, its importance in the make-up of present-day civilization and the wide diversity of situations it is competent to meet.

A feature of the conference was an interesting mathematical exhibition, which was formally opened by Sir C. P. Ramaswamy Iyer. The

exhibition included models relating to geometrical surfaces and solids, topology, astronomy, etc., statistical charts, besides photoprint copies of Ramanujan's notebooks which form the property of the University of Madras.

About 30 papers were presented at the conference, covering topics on Modern Algebra and Abstract Spaces, Theory of Numbers, Analysis, Geometry, Astronomy and Statistics. There were symposia on 'Recent Developments in Harmonic Analysis' with Prof. M. H. Stone as the principal speaker, on 'Time Series Analysis' with Prof. H. Wold as the principal speaker, on 'Fluid Mechanics' with Prof. O. G. Tietjens and Dr. Ghatge as the principal speakers, also one on the 'Teaching of Mathematics,' the discussion on which was initiated by Dr. A. Narasinga Rao and Dr. T. Vijayaraghavan.

The conference was well organised and rendered lively on its social side by Tea, Excursions and an excellent *Kala Pradarshan* (including Music and Bharatha Natya) arranged by the authorities of the Theosophical Society, Adyar.

THE INDIAN INSTITUTE OF SCIENCE, BANGALORE

THE Governing Council of the Indian Institute of Science will soon be confronted with the difficult and responsible task of appointing scientific men of eminence, experience and character for the many professorships which have remained vacant for some time. It will generally be conceded that the reputation and status of the Institute has recently been challenged and has evoked a considerable amount of adverse, perhaps undeserved, comment. All the well-wishers of the Institute, including the old and the present "boys", are eager to see that the scientific status of the Institute is raised to a position of internationally recognised pre-eminence.

The circumstance that five or six professorial chairs have to be filled in, offers the Governing Council and the Government of India, who have in recent years developed a deep and substantial interest in the welfare and ordered progress of the Institute, an exceptional opportunity to invite eminent men who can bring prestige and add lustre to the Institute. In making the choice, parochial consideration should be eschewed and it should be remembered that first class men would not respond to a casual advertisement in the Daily Press and in Scientific Journals. Such men will have to be invited and induced to accept the Chairs. In this attempt, we should cast our net over a wide transcontinental area, offer attractive terms and a reasonably long period of tenure and create a healthy atmosphere of academic freedom devoid of bureaucratic control and red tape.

India's prestige in other countries stands high, thanks to our Pandit Nehru and his recent visit to the continent and the U.S.A. It would not at all be difficult to secure the services of eminent scientists. As Sir S. S. Bhatnagar recently declared in the course of his Joint Convocation Address to the Harcourt Butler Technological Institute and the Indian Institute of Sugar Technology (4-11-'49) "there is no need to fight shy of getting suitable men from foreign countries, if suitable and fully qualified Indians are not yet available".

Discussing the recruitment of scientific men for positions of responsibility, Dr. Kenneth

Mees, Vice-President in charge of Research, Eastman Kodak Company, emphasises the need for exercising the greatest amount of care and thought in the selection of men, "since it is very difficult to remove him and his removal involves a great disruption of work". He adds "Occasionally those responsible for the organisation will realise that they have made a mistake—that the man they have chosen cannot do the work set before him—and then there should be no hesitation in making a change. This may seem an easy thing to do, but it is really very difficult. The great defect in management of all kinds is the tendency of those in authority to tolerate inefficiency rather than face the unpleasant task of removing the inefficient."

Dr. Mees utters a helpful word of caution when he declares: "The great danger is that the institutes might fall victims to a system of political jobbery and that the staff and even the director might be appointed for other reasons than their competence. This difficulty, however, would supply its own remedy. The picture would simply fail, and the advance of Baidya, locally checked, would proceed elsewhere."

For experience has not been very encouraging; appointments made in a moment of patriotic fervour in the teeth of well-meant opposition, have not proved the success that was forecast at the time. The most depressing consequence of appointing men of low calibre, consists in the perpetuation of mediocrity; under such an auspices, the level of scientific work will not be permitted to rise above that of the man in authority. Usually, there is little chance for promising careers to develop to their full stature.

There is no use in thinking of the past; we wish to make an earnest appeal to the representatives of the Tatas—the great and illustrious founders of the Institute, the Governing Council of the Institute and the Government of India to utilise this golden opportunity for staffing the Institute with eminent men of science and thereby earn the everlasting gratitude of the rising generation of scientific men in this country.

ASTRONOMICAL INSTRUMENTS FOR INDIA

During his recent visit to the U.S.A., Pandit Jawaharlal Nehru paid a brief call at Harvard, where he discussed with Dr. Harlow Shapley and others the future of India's observatories. As a result, a new Schmidt-type telescope is being planned for Allahabad University

Observatory in the north and a solar coronagraph for the Kodaikanal Solar Observatory. Dr. A. C. Banerji, of Allahabad, has been deputed to go to America to get the first of these projects under way, and Dr. A. K. Das, the other.

THE INDIAN ACADEMY OF SCIENCES

THE fifteenth annual session of the Indian Academy of Sciences was held this year at the Royal Institute of Science, Bombay, on 29th, 30th and 31st December 1949, under the distinguished presidency of Prof. Sir C. V. Raman. Over fifty fellows and more than a hundred delegates from different parts of India attended the session. Among the overseas delegates who attended the session, were Prof. J. D. Bernal and Prof. Sir Robert Robinson from England, Prof. and Madame Joliot-Curie from France, Prof. O. E. H. Rydbeck from Sweden and Prof. Hermann Mark and Dr. E. U. Condon from the U.S.A.

His Excellency Raja Maharaj Singh, Governor of Bombay and Chancellor of the Bombay University, opened the session and the inaugural address was delivered by Mr. B. G. Kher, the Premier of Bombay. Prof. Raman's presidential address was on "Thirty Years of Light Scattering" in which he gave a brief review of the growth of the subject of light scattering since the time he took up the study of this phenomenon. In the early days, even the existence of scattering of light by a pure dust-free liquid was doubted, but experiments made by Raman and his co-workers showed clearly that the molecules of a liquid do scatter light. These studies led to the publication of a book on the "Molecular Scattering of Light", by Raman in 1923. The subject was pursued with great vigour since then and resulted in the discovery of the "Raman Effect". This effect has found numerous applications, not only in Physics, but in Chemistry, Mineralogy and even Biology for the elucidation of molecular structures and for the identification of chemical compounds. In recent years, Raman effect studies have been extended to crystals also, mainly by Dr. R. S. Krishnan using the 2537 Å resonance radiation of mercury for excitation, and the results obtained from these have led to entirely new conceptions regarding the solid state of matter.

The high-lights of the session were the addresses by the foreign delegates. Prof. Rydbeck spoke on "The Interaction between Electron Beams and Travelling Electromagnetic Waves". He also showed a motion picture of the ionosphere taken at the Royal Swedish Academy's new observatories, which exhibited the variation of the height of the reflecting layers for frequencies from 1 to 20 Mc. both under steady conditions and when auroral disturbances were present. Prof. Rydbeck explained that attempts to explain the results of these observations regarding the propagation of radio waves in the

ionosphere led him to theoretical ideas which have found practical application in the design of new types of wide-band amplifiers, in which energy could be transferred from electron beams to electromagnetic waves and *vice versa*.

Madame Joliot-Curie gave an account of the "Evolution of Nuclear Physics". She described the early days of the discovery of radioactivity, the pioneering work of Becquerel, the Curies, Rutherford and others, the discovery of artificial transmutation and of induced radio-activity, the recognition of new elementary particles such as the neutron and the positron, and ended up with the experiments on nuclear fission and the release of atomic energy. Prof. F. Joliot-Curie limited himself to the subject of "Artificial Radio-activity and gave (to quote Prof. Raman) "an interesting human story" of the development in the field. In passing, Prof. Joliot also mentioned how work is being directed in France towards developing the constructive uses of atomic energy.

Prof. Bernal gave a public lecture on the use of "X-rays in Organic Chemistry". He mentioned that, at present, X-ray methods have been developed to such an extent that they can very favourably compare with, and may even be superior to, orthodox methods of the organic chemist in analysing the structure of organic compounds. He gave numerous examples where not only the stereochemical structure can be obtained by such methods but also the exact distances between the various constituent atoms. Penicillin is the classical example of the success of X-ray methods, where the constitution was first found by X-rays and later verified by organic chemical methods. Prof. Bernal believed that organic chemists would soon hand over the analytical part of their work to the X-ray crystallographer and limit themselves only to the synthesis of organic compounds.

Prof. Mark spoke on "Light Scattering in Polymer Solutions". The theory of this was first given by Raman in 1931, but was not applied then because no suitable materials were available for testing the theory and because the experimental techniques were not adequate for the purpose. With the preparation of modern high polymers and with the development of photo-multiplier tubes, the subject has again come into prominence and the theory has been revived by Debye and others. Prof. Mark explained how precise measurements of the scattering of light in solutions of high polymers could lead to the determination of the molecular

weight and also the thermodynamic interaction between the macromolecules and the solvent.

Prof. Robinson gave a review of the work done by him and his co-workers on the structure of organic compounds. During his address, he referred to the investigations carried out by various Indian students who had worked in his laboratory.

A number of papers were presented during the scientific meetings of Section A and B. It is not possible to review them all here, but reference may be made to one or two. Prof. H. J. Bhabha spoke about a new theory of nuclear forces, which had emerged as a result of the work done at the Tata Institute of Fundamental Research, and which appeared to be an improvement on the Yukawa theory. Prof. R. S. Krishnan presented some results of direct spectroscopic observation of the Brillouin effect in crystalline and fused quartz. This is the first time that genuine photographs of the effect have been obtained with an amorphous

material. A symposium was held on "Research in Cotton Textile Industry". This was opened by Dr. K. Venkataraman and various invited reports were submitted. In the discussion which followed, Prof. Mark also took part.

The concluding public lecture was given by Prof. Raman on the "Luminescence of solids". In addition to a general discussion of the subject, Prof. Raman also gave a detailed account of the luminescent properties of diamond. Formerly, the luminescence of diamond had been attributed to the presence of impurities, but the investigations at Bangalore made by Raman and his collaborators have established that this is not so, but that it arises from the intermixture of the four possible structures of diamond. Towards the end of the lecture, Prof. Raman gave a beautiful display of luminescent minerals by exhibiting to the audience the luminescence of various specimens of natural rocks by illuminating them with an ultra-violet lamp.

MOLECULAR INTERACTION*

THE forces exerted by molecules on each other is of such a nature that a vast field of investigation can be conveniently brought under this head, as can be readily seen in the report of a conference on the subject by the New York Academy of Science. Soap solutions, colloids, proteins and high polymers figure prominently in intermolecular attraction studies. Similarly, hydration often presents interesting problems in dealing with electrolytes. Whatever the particular topic chosen we find approaches both from the experimental and from the theoretical angle. Unlike the Faraday Society Discussions, we have here a collection of seventeen monographs, each standing independently and there is no attempt to group together those dealing with closely related topics nor a general survey in an introduction.

Using a simple experimental technique with an easily rigged up fluorimeter, Debye has studied the scattering (classical) by soap solutions, interpreting the results in accordance with the theory developed by him, correlating the number of particles and refractive index of solvent and solute with the measured turbidity. Deviations from ideal behaviour is noticeable with even dilute solutions of high polymers and mixed solvents clearly indicate the complex nature of the solutions. The experimental observations are used by him to give a tentative

picture of the micelle differing from that of McBain.

The Debye-Hückel theory naturally figures in the symposium. Robinson and Stokes discuss the role of hydration and consider the evidence for hydration from values of ionic radii and the thermodynamic properties of concentrated solutions. They are led to conclude that cations hydrate more readily than anions and attribute all temperature effects solely to hydration number.

While the agreement between theory and experiment appears to be remarkably good further work is obviously necessary before one can accept the position as pictured. The theoretical and experimental study of the reaction between Proteins and hydrochloric acid or potassium hydroxide in the presence and absence of added sodium and potassium chloride and the application of Debye-Hückel theory to protein titrations are considered by Scatchard. In discussing the answer to the questions "How many" and "How tightly bound" are the small molecules with the proteins, Scatchard has clearly shown the importance of the greatest possible precision in measurements in the interpretation of curves, particularly where extrapolation is needed. Among the properties of solutions of electrolytes to which the Debye-Hückel theory has been applied, one that presented difficulties is the heat of dilution. With the accuracy then available Bjerrum could go down to only a concentration of one mole of electrolyte in 400 moles

* *Annals of the New York Academy of Sciences*, Vol. 51, Article 4. Price 4.00 dollars.

of water. Microcalorimetry has advanced considerably since then and one of the principal contributors to this development, Gucker has given an account of thermal properties in a highly condensed article. Among other material presented, we have a useful description of the experimental set up for microcalorimetry and measurements of specific heats and one gets the information of the scale of thermometric accuracy:

Best mercury thermometer: 76 mm. per degree centigrade

Platinum Resistance thermometer: 4 metres per degree centigrade

1000-Junction thermal: 1 kilometre per degree centigrade!

Evidence is presented in the article showing the verification of the Debye-Hückel theory for 1-1, 2-1, and 1-2 electrolytes but at the same time we notice that except at the greatest dilutions, the individuality of all electrolytes in their thermal behaviour still awaits solution. Applications of the limiting law and the results of extremely dilute solutions have their limitations and this is well brought out by Owen and Brinkely in their study of the apparent molal properties of strong electrolytes. The influence of electrophoresis was first taken note of by Debye and Hückel in dealing with electrolytes while Onsager and Fuoss have extended the theory to electrolytic diffusion. Harned and Nuttall have presented experimental evidence in support of the Onsager-Fuoss theory using solutions of potassium chloride solutions and the method adopted by them is remarkably simple and direct. The well-known work of Kraus and his associates on nonaqueous solvents is presented

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The volume is particularly valuable for a lucid presentation of Brönsted's new Thermodynamic Theory by La Mer. One wishes that the monograph had been longer as the greater part of Brönsted's work in this field is accessible only in Danish.

Mention should also be made of the terse mathematical contribution of Onsager on the effect of shape on the interaction of colloidal particles.

The series of critical surveys comprising the volume is suggestive of further work and the volume should be a valuable addition to the library of any institution for advanced studies, particularly to those working in related fields. For its contents the price is quite a reasonable one.

S. V. ANANTAKRISHNAN.

LADY TATA MEMORIAL TRUST SCIENTIFIC RESEARCH SCHOLARSHIPS, 1950-51

THE Trustees of the Lady Tata Memorial Trust are offering six Scholarships of Rs. 250 each per month for the year 1950-51 commencing from 1st July 1950. Applicants must be of Indian nationality and Graduates in Medicine or Science of a recognised University. The Scholarships are tenable in India only and the holders must undertake to work whole-time under the direction of the head of a recognised research Institute or Laboratory on a subject

of scientific importance, having a bearing either directly or indirectly on the alleviation of human suffering from disease. Applications must conform to the instructions drawn up by the Trustees. Candidates can obtain these instructions and other information they desire from the Secretary of the Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay 1.

OBSERVATIONS ON SOME COMMON DEFICIENCY DISEASES IN INDIA*

THE incidence of diseases due to faulty nutrition or undernutrition is high in a country like India. With the advent of the newer knowledge in the field of nutrition, several conditions which had remained obscure before were traced to deficiency in the diet. Dr. Rao had the opportunity of studying deficiency diseases during the last 15 years and the observations made are based on his personal experience. He has discussed briefly some of the clinical entities associated with malnutrition, *viz.*, cutaneous manifestations in deficiency disease, nutritional diarrhoea, hypoproteinaemia, cirrhosis of the liver, and tropical ulcer (Naga sore).

Dealing with cutaneous manifestations in deficiency disease the author summarises that the histological findings in phrynodermia namely, the primary non-inflammatory hyper-keratosis of epithelium, the involvement of the cutaneous glands and hair and the absence of vascular changes or hæmorrhages in perifollicular tissues strongly suggests that the condition is a manifestation of nutritional deficiency in which lack of vitamin A is an important factor. Other factors, such as secondary food deficiencies, deficiency of essential fatty acids, the stage of sexual development a familial need for abnormally large amounts of vitamin A, or a racial susceptibility may perhaps influence the development of the lesion.

Cases of chronic diarrhoea of obscure etiology are quite common and no systematic investigation of this condition had been carried out. Dr. Rao has studied experimentally the effects on monkeys of long continued feeding on poor rice diets resembling those consumed by human beings in India and found that a chronic deficiency state was produced in which the dominating clinical sign was diarrhoea. The jejunum and ileum showed varying degree of atrophy. Clinical picture similar to this has been reported in human beings by several observers and

such manifestations were controlled by simple dietetic treatment.

It has been found that a condition of hypoproteinaemia in India is undoubtedly due to the deficient intake of proteins for economic and other reasons. The albumen fraction of the plasma protein is the one significantly disturbed in malnutrition. The deficiency state manifests itself by œdema of the subcutaneous tissues associated with varying degree of anæmia. Such cases were found to improve remarkably with high-protein diet alone.

Regarding cirrhosis of the liver, investigations carried out in South India showed that dietetic deficiency is an important factor in the causation of the disease. Dr. Rao has briefly described the different clinical types of cirrhosis of the liver met with in India and discusses the etiological factors with special reference to nutritional deficiencies. The disease takes a high toll of life among Indian children. Portal cirrhosis is associated with nutritional deficiencies and clinical trials suggest that a richly nutritious diet may have a beneficial effect on the clinical course of the disease, if treatment is instituted early in the decompensated stage.

The last condition which the author draws attention to is 'tropical ulcer' or 'naga sore'. During recent years it has become increasingly evident that malnutrition plays an important part in the rapid spread and delayed healing of the ulcer. Apart from the specific local treatment of the ulcer, the author suggests that attention should be paid to improving the general nutritional state of the patient.

In a country like India where famine and pestilence are frequent and ignorance and superstitions are rife, it is not surprising that incidence of diseases due to faulty nutrition is very high. In his address, Dr. Rao has given an account of some of the common diseases associated with malnutrition, but does not claim that the list given is either complete or exhaustive. He, however, emphasises the fact that prevalence of such diseases illustrates the magnitude of the problem of malnutrition in our country.

N. N. DE.

* Abstract of the Presidential Address delivered by Dr. M. V. Radhakrishna Rao, at the Section of Medical and Veterinary Sciences, 37th Indian Science Congress, Poona, 1950.

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OBSERVATIONS ON SOME COMMON DEFICIENCY DISEASES IN INDIA*

THE incidence of diseases due to faulty nutrition or undernutrition is high in a country like India. With the advent of the newer knowledge in the field of nutrition, several conditions which had remained obscure before were traced to deficiency in the diet. Dr. Rao had the opportunity of studying deficiency diseases during the last 15 years and the observations made are based on his personal experience. He has discussed briefly some of the clinical entities associated with malnutrition, viz., cutaneous manifestations in deficiency disease, nutritional diarrhoea, hypoproteinæmia, cirrhosis of the liver, and tropical ulcer (Naga sore).

Dealing with cutaneous manifestations in deficiency disease the author summarises that the histological findings in phrynodermia namely, the primary non-inflammatory hyper-keratosis of epithelium, the involvement of the cutaneous glands and hair and the absence of vascular changes or hæmorrhages in perifollicular tissues strongly suggests that the condition is a manifestation of nutritional deficiency in which lack of vitamin A is an important factor. Other factors, such as secondary food deficiencies, deficiency of essential fatty acids, the stage of sexual development a familial need for abnormally large amounts of vitamin A, or a racial susceptibility may perhaps influence the development of the lesion.

Cases of chronic diarrhoea of obscure etiology are quite common and no systematic investigation of this condition had been carried out. Dr. Rao has studied experimentally the effects on monkeys of long continued feeding on poor rice diets resembling those consumed by human beings in India and found that a chronic deficiency state was produced in which the dominating clinical sign was diarrhoea. The jejunum and ileum showed varying degree of atrophy. Clinical picture similar to this has been reported in human beings by several observers and

such manifestations were controlled by simple dietetic treatment.

It has been found that a condition of hypoproteinæmia in India is undoubtedly due to the deficient intake of proteins for economic and other reasons. The albumen fraction of the plasma protein is the one significantly disturbed in malnutrition. The deficiency state manifests itself by oedema of the subcutaneous tissues associated with varying degree of anæmia. Such cases were found to improve remarkably with high-protein diet alone.

Regarding cirrhosis of the liver, investigations carried out in South India showed that dietetic deficiency is an important factor in the causation of the disease. Dr. Rao has briefly described the different clinical types of cirrhosis of the liver met with in India and discusses the etiological factors with special reference to nutritional deficiencies. The disease takes a high toll of life among Indian children. Portal cirrhosis is associated with nutritional deficiencies and clinical trials suggest that a richly nutritious diet may have a beneficial effect on the clinical course of the disease, if treatment is instituted early in the decompensated stage.

The last condition which the author draws attention to is 'tropical ulcer' or 'naga sore'. During recent years it has become increasingly evident that malnutrition plays an important part in the rapid spread and delayed healing of the ulcer. Apart from the specific local treatment of the ulcer, the author suggests that attention should be paid to improving the general nutritional state of the patient.

In a country like India where famine and pestilence are frequent and ignorance and superstitions are rife, it is not surprising that incidence of diseases due to faulty nutrition is very high. In his address, Dr. Rao has given an account of some of the common diseases associated with malnutrition, but does not claim that the list given is either complete or exhaustive. He, however, emphasises the fact that prevalence of such diseases illustrates the magnitude of the problem of malnutrition in our country.

N. N. DE,

* Abstract of the Presidential Address delivered by Dr. M. V. Radhakrishna Rao, at the Section of Medical and Veterinary Sciences, 37th Indian Science Congress, Poona, 1950.

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TERM VALUES IN THE 'f³' ELECTRON CONFIGURATION

APPLYING Slater's wave-mechanical method* (1929) to the problem of the 'f³' equivalent electron configuration, the term-values are calculated. The same problem was treated by Racah (1943) by his new tensor method. The results seem to be the same. A few discrepancies are, however, noticed and discussed.

The energies are computed in terms of the well-known F's and G's from the tables for a^k's and b^k's given by Condon (1933). All the term values are collected in Table I. Terms occurring twice are bracketed, and only their mean values are given. The

values given by Racah are also converted into F's by the relationships given by Racah and presented in the table for comparison. It can be seen that ⁴D, ⁴S, ²L, ²F and ²D of our values do not agree with those given by Racah.

²L.—The calculation is simple since it occurs uniquely as (3⁺ 3⁻ 2⁺). The term value can be calculated thus:

$$\begin{aligned}
 (3^+ 3^-) &= F_0 + 25/225 F_2 + 3/1089 F_4 \\
 &\quad + 1/7361.6 F_6 \\
 (3^- 2^+) &= F_0 - 21 F_4 - 6 F_6 \\
 (3^+ 2^+) &= F_0 - 21 F_4 - 6 F_6 \\
 &\quad - 25 G_2 - 30 G_4 - 7 G_6
 \end{aligned}$$

which on simplification gives the result shown in the second column in the table.

Term	Value (Author)				Value (Racah's)			
⁴ I	= 3F ₀ -	65F ₂ -	141F ₄ -	221F ₆	3F ₀ -	65F ₂ -	141F ₄ -	221F ₆
⁴ G	3F ₀ -	10F ₂ -	75F ₄ -	1222F ₆	3F ₀ -	10F ₂ -	75F ₄ -	1222F ₆
⁴ F	3F ₀ -	30F ₂ -	99F ₄ -	858F ₆	3F ₀ -	30F ₂ -	99F ₄ -	858F ₆
⁴ D	3F ₀ +	$\frac{25}{225}F_2 - \left(42 - \frac{9}{1089}\right)F_4 - \left(2060 - \frac{1}{7361}\right)F_6$			3F ₀ +	25F ₂ -	33F ₄ -	1859F ₆
⁴ S	3F ₀ -	30F ₂ -	99F ₄ -	658F ₆	3F ₀ -	30F ₂ -	99F ₄ -	858F ₆
² L	3F ₀ -	$\left(25 - \frac{25}{225}\right)F_2 - \left(72 - \frac{9}{1089}\right)F_4 - \left(19 - \frac{1}{7361}\right)F_6$			3F ₀	-	63F ₄ -	18F ₆
² K	3F ₀ -	40F ₂ +	F ₄ -	38F ₆	3F ₀ -	40F ₂ +	F ₄ +	38F ₆
² I	3F ₀ -	5F ₂ -	6F ₄ -	305F ₆	3F ₀ -	5F ₂ -	6F ₄ -	305F ₆
(² H)	3F ₀ -	23F ₂ -	46.5F ₄ -	136F ₆	3F ₀ -	23F ₂ -	46.5F ₄ -	136F ₆
(² G)	3F ₀ +	7F ₂ +	24.5F ₄ -	620F ₆	3F ₀ +	7F ₂ +	24.5F ₄ -	620F ₆
(² F)	3F ₀ +	$\left(30 + \frac{25}{225}\right)F_2 + \left(46.5 + \frac{9}{1089}\right)F_4 + \left(51 - \frac{1}{7361}\right)F_6$			3F ₀ +	55F ₂ -	55.5F ₄ -	52F ₆
(² D)	3F ₀ -	5.5F ₂ -	27F ₄ +	29.5F ₆	3F ₀ -	7F ₂ -	31.5F ₄ -	130F ₆
² P	3F ₀ -	25F ₂ -	44F ₄ +	143F ₆	3F ₀ -	25F ₂ -	44F ₄ +	143F ₆

(Fractions like $\frac{9}{1089}$, etc., can be neglected without practically any effect on the values)

⁴D and ⁴S.—The values given by Racah indicate that ⁴F and ⁴S have equal energies which is not possible, for, then they are indistinguishable. Theoretically ⁴S with the lesser *l* value should lie higher than ⁴F : a feature which is clearly maintained in our values. The difference is 200 F₆.

The case of ⁴D cannot be demonstrated so easily. But the values obtained by us are believed to be correct. Among the other doublets, while the values for ²G and ²P agree, those for ²F and ²D do not agree. Our method of calculation being by successive steps, if ²G and ²P are correct then the correctness of the values of ²F and ²D may be presumed to be correct (the latter being derived from ²G and ²P from ²D values). The author suggests that Racah's values might be redetermined to detect errors, and discrepancies if any between the values derived from the two independent methods of calculation.

The author wishes to thank Dr. K. R. Rao and Dr. S. Minakshisundaram for their interest in the work.

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October 6, 1949.

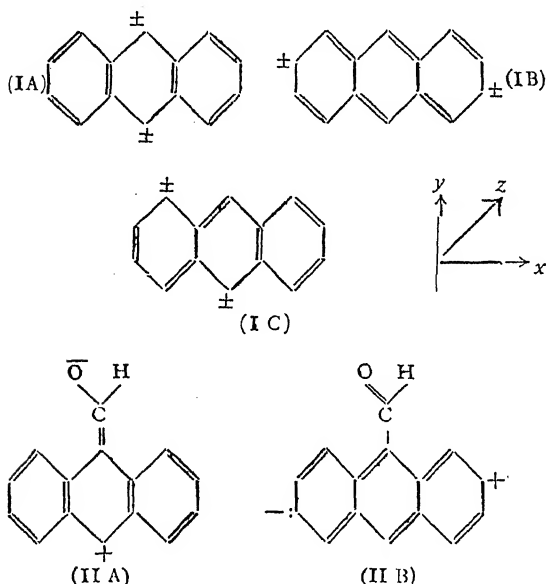
*Details of the method are given in Slater's paper (1929).

1. Condon, *Phy. Rev.*, 1930, 36, 1121. 2. Condon and Shortley, *Ibid.*, 1931, 37, 1025. 3. Racah, *ibid.*, 1943, 62, 438. 4. Slater, *Ibid.*, 1929, 34, 1293.

DIPOLE MOMENTS OF RESONANCE STRUCTURES AND THE ULTRAVIOLET ABSORPTION MAXIMA OF ANTHRACENE

In approximately linear molecules, such as the polyenes, the polyphenyls and the cyanines, the large polarizability responsible for colour in the visible region is along one axis, and the major or *x*-axis will be more or less along the line of maximum extension; but in malachite green and other compounds in which the conjugated system extends in two dimensions, Lewis and Calvin have shown that we are no longer dealing with even approximately linear oscillators.¹ Two fundamental bands corresponding to the two axes of oscillation can sometimes be identified (*x* and *y* bands). When a planar molecule does not possess a centre of symmetry, *x* and *y* bands are to be anticipated, but the location of the *y* band in the spectrum may be difficult because of a great difference in the intensities of the two bands, if the polarizability or electron mobility in one direction is much larger than in the other. In the case of a few relatively simple and approximately linear molecules (*p*-azoxy-anisole,² diphenyloctatetraene and diphenyldodecahexaene³) for which X-ray data have indicated the relative position of the atoms in the crystals and hence the direction of the axis of the molecule, it has been found by examining the absorption of polarized light that the absorption is at a maximum when the electric vector of the polarized light is roughly along the axis of the molecule.

In the absorption spectrum of anthracene there are two well-defined bands: a long-wave, low-intensity band (λ_{\max} 3800 Å; $\log \epsilon_{\max}$ 3.8) possessing vibrational fine structure, and a short-wave, high intensity band (λ_{\max} 2500 Å; $\log \epsilon_{\max}$ 5.2).⁴ The short-wave and the long-wave series of maxima can be respectively associated with electronic activations (cf. structures I A, I B and I C) polarized in two directions perpendicular to each other in the plane of the molecule. Comparing the spectra of anthracene and 9-anthraldehyde (II), in



which the 9-aldehyde group effects a marked bathochromic shift of the long-wave band, together with loss of fine structure, Jones⁴ has suggested that the long-wave band is associated with an electrical moment oriented approximately in a vertical direction (y band). Structure (II A) in which the negative charge is on an oxygen atom should make a much larger contribution to the excited state of 9-anthraldehyde than the corresponding structure (IA) for anthracene; the result should be a larger displacement of an absorption band associated with excitation along the y -axis than of a band associated with an electric moment oriented in the x direction.⁴ Another consideration which confirms this suggestion of Jones is a comparison of the dipole moments of structures (A) and (B) for anthracene (I), computed as 15.0 D and 34.5 D respectively. Intensities of absorption are related to dipole moments, and the

larger dipole moment of (I B) clearly indicates that x -polarization gives rise to the short-wave high-intensity band; and y -polarization which has a smaller dipole moment gives rise to the long-wave low-intensity band. Applying the method of molecular orbitals to the ultraviolet absorption of the polyacene series (naphthalene to pentacene) Coulson⁵ has shown that the longest wave-length in an allowed excitation probably arises from a transition between mobile electron levels of symmetry $A_{1g} \rightarrow B_{2u}$ and polarized across the width of the molecule; the second wave-length is due to a transition $A_{1g} \rightarrow B_{1u}$, polarized along the length of the molecule.

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1. Chem. Revs., 1939, 25, 273. 2. Bernal and Crowfoot, Trans. Farad. Soc., 1933, 29, 1032.
3. Calvin, quoted in ref. (1) 4. Jones, Ibid., 1945, 67, 2127; Chem. Revs., 1947, 41, 353.
5. Proc. Phys. Soc., 1948, 60, 257.

THE EFFECT OF SUPPLEMENTARY ZINC ON THE FAT CONTENT OF LIVERS AND DEVELOPMENT OF THE BONES OF RATS

ALBINO rats fed on a diet containing 30 per cent. fat (hydrogenated groundnut oil), 10 per cent. alcohol-washed casein (choline content 0.15 mg. per cent.) and the necessary salts and vitamins, developed fatty livers during an experimental period of fifteen days. As Table I will show, the fat content was lowered considerably with a supplement of zinc.

It has been reported^{1,2} that diets supplemented with zinc at high levels led to anæmia, loss of weight and death of the rats in six weeks. Likewise, diets containing 0.5 and 1.0 per cent. levels of zinc oxide were found to affect bone development adversely whether the basal diet was normal stock ration or a high fat, low protein ration as mentioned above. Tables II and III summarize the results for stock diet and high fat, low protein diet respectively.

TABLE I

Analysis of liver of rats on diets supplemented with zinc

Diets	Initial body weight	Final body weight	Average daily food intake	Fresh weight of liver	Weight of liver as per cent. of body weight	Fat in liver	Percentage of fat in liver
	gm.	gm.	gm.	gm.	%	gm.	%
1 High fat, low protein diet*	50	63	7.7	5.26 (± 0.43)	8.35 (± 0.55)	1.2775 (± 0.30)	24.29 (± 3.9)
2 Do. plus 0.5 per cent. zinc oxide	47	53	6.3	4.04 (± 0.16)	7.62 (± 0.22)	0.5727 (± 0.12)	14.18 (± 2.27)
3 Do. plus 1.0 per cent. zinc oxide	45	47	5.1	3.03 (± 0.16)	6.45 (± 0.19)	0.3687 (± 0.08)	12.17 (± 1.96)
4 Ten per cent. fat, 10 per cent. casein diet	53	76	9.6	6.08 (± 0.27)	8.00 (± 0.15)	1.0367 (± 0.13)	17.05 (± 1.60)
5 Do. plus 1.0 per cent. zinc oxide	48	47	6.9	2.78 (± 0.23)	5.91 (± 0.23)	0.1420 (± 0.04)	5.11 (± 1.24)

* The diet consisted of 30 per cent. hydrogenated groundnut oil, 10 per cent. alcohol-extracted casein, 4 per cent. salt mixture, 56 per cent. sucrose and vitamins.

TABLE II

Analysis of bones of rats on a stock diet supplemented with zinc

Diet	Final body weight	Dry weight of femurs	Ash weight	Ash per cent.	Calcium (Ca)	Phosphorus (P)	Ca/P
	gm.	gm.	gm.	%	mg.	mg.	
1 Stock diet	138.0 (± 2.9)	0.3875 (± 0.009)	0.1990 (± 0.0063)	51.35 (± 0.94)	68.28 (± 2.14)	40.35 (± 0.8)	1.692 (± 0.066)
2 Do. plus 0.5 per cent. zinc oxide	139.5 (± 8.3)	0.3248 (± 0.028)	0.1553 (± 0.0153)	47.81 (± 1.27)	54.51 (± 5.39)	33.30 (± 2.3)	1.637 (± 0.03)
3 Do. plus 1.0 per cent. zinc oxide	116.0 (± 5.7)	0.2638 (± 0.011)	0.0998 (± 0.0098)	38.27 (± 2.65)	32.63 (3.52)	25.05 (± 1.91)	1.303 (± 0.046)

TABLE III

Analysis of bones of rats on a high fat low protein diet supplemented with zinc

Diet	Final body weight	Dry weight of femurs	Ash weight	Ash per cent.	Calcium (Ca)	Phosphorus (P)	Ca/P
	gm.	gm.	gm.	%	mg.	mg.	
1 High fat, low protein diet	63	0.2430 (± 0.008)	0.0898 (± 0.0075)	35.95 (± 0.56)	34.8 (± 0.79)	14.70 (± 1.58)	2.53 (± 0.31)
2 Do. plus 0.5 per cent. zinc oxide	53	0.2195 (± 0.009)	0.0643 (± 0.0027)	29.23 (± 0.64)	24.4 (± 1.21)	11.00 (± 1.07)	2.22 (± 0.20)
3 Do. plus 1.0 per cent. zinc oxide	47	0.1863 (± 0.009)	0.0512 (± 0.0022)	27.48 (± 1.34)	18.6 (± 0.84)	8.55 (± 0.41)	2.21 (± 0.16)
4 Ten per cent. fat, 10 per cent. casein diet	76	0.2477 (± 0.009)	0.1120 (± 0.0023)	45.22 (± 0.53)	40.8 (± 0.93)	19.52 (± 0.32)	2.09 (± 0.04)
5 Do. plus 1.0 per cent. zinc oxide	47	0.1563 (± 0.011)	0.0502 (± 0.0035)	32.12 (± 1.32)	17.6 (± 2.30)	8.74 (± 1.07)	2.01 (± 0.04)

Tables II and III indicate the relation between the fat content and the changes brought about by zinc in the diet. Thus, for the groups in 4 and 5, when the fat content

of the diet is low, the changes brought about by zinc are more pronounced than when zinc is supplemented to a high fat, low protein diet. The decrease in daily

food intake as a result of supplementing with zinc leads to the suggestion that the lowered fat content of livers in rats of these groups may be due to the lowered intake of same. This, however, is not the case. From the results presented in Table I, it is seen that for a decrease in food intake of 18 and 34 per cent. in groups 2 and 3 respectively there is a corresponding decrease in fat content of approximately—56 and 71 per cent. in the liver. Details will be published elsewhere.

Thanks are due to Major-General Sir S. S. Sokhey, Kt., Director, and Dr. K. Ganapathi, D.Sc., Assistant Director, for their interest in the work.

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1. Sutton, W. R., and Nelson, V. E., *Proc. Soc. Exper. Biol. and Med.*, 1937, 36, 211. 2. Smith, S. E., and Larson, E. J., *J. Biol. Chem.*, 1946, 163, 29.

EFFECT OF CONCENTRATION ON TEMPERATURE COEFFICIENT OF DDT ACTION ON INSECTS

THE author (Pradhan, 1949)¹ reported recently:

- (1) That insects' resistance to poisons increases with rise of temperature upto a certain degree and then decreases with any further rise of temperature.
- (2) That the amount of poison reaching the site of action in unit time also generally increases with rise of temperature.
- (3) That apparent rise or fall in toxicity with increase of temperature is the resultant of the above two factors.

These generalisations fitted under one general plan most of the apparently discordant observations of various workers. After sending these to press there appeared a contribution (Fan, Cheng & Glenn Richards, 1948)² reporting that "following external application, highly susceptible arthropods show either a positive or a negative temperature coefficient for mortality as a function of DDT concentration or dosage". "At high concentrations this is positive" and "at low concentrations this is negative". They conclude that "at low concentrations DDT

penetrates the arthropod cuticle more effectively at low temperatures".

The present note suggests another interpretation of the phenomenon.

The contact between the chemical DDT and the insect body is likely to initiate some sort of physico-chemical reaction resulting in the death of the latter. At constant temperature the rate of this reaction should be proportional to the concentration of DDT. Further, at any concentration rise of temperature increases the reaction velocity. Temperature may also favour diffusion of DDT into the insect body which may enhance the reaction. Thus according to physico-chemical principles the reaction between DDT and the insect leading to latter's death should have positive coefficient both for temperature and for concentration.

Further let us make a simple supposition that the poison enters the insect system along with its carrier and that the carrier entering per unit time increases with each degree rise of temperature by 100 units (Fig. 1, K). Now if the concentration of

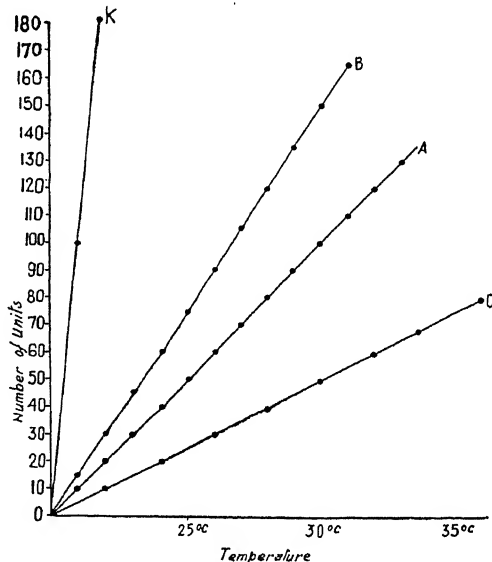


FIG. 1.* Number of Units (hypothetical) of DDT (A, B, C) and carrier (K) entering insect system per unit time at different temperatures.

DDT in the carrier is 5%, the entry of DDT per unit time will increase by 5 units per degree rise (Fig. 1, C) but if the concentration of DDT in the carrier is 10% or 15% the increase will be 10 or 15 units per degree rise respectively (Fig. 1, A, & B). Further, supposing the entry of an extra unit of DDT can bring about an additional 1%

mortality the corresponding curves A, B, and C in Fig. 2 will show increased mortality at

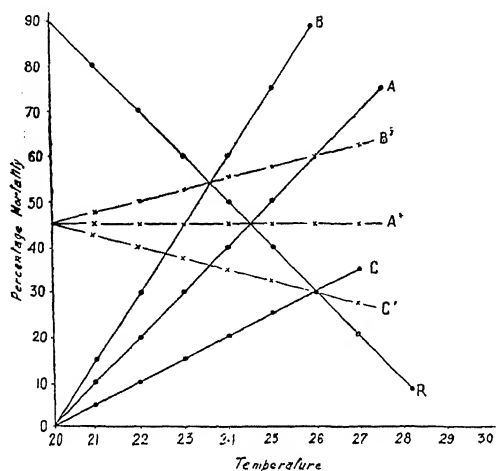


FIG. 2.* Interaction between positive (A, B, C) and negative (R) temperature coefficients resulting in positive (B') negative (C') and nullification (A').

higher temperatures due to more poison reaching the site of action (generalisation No. 2).

Now with rise of temperature (generalisation No. 1) there is increase in insect's resistance which exhibits itself as a negative temperature coefficient of insect mortality (Fig. 2, R). This negative temperature coefficient of insect mortality would naturally try to nullify the positive temperature coefficient of insect mortality due to increased DDT entry and the temperature coefficient of insect mortality actually observed in experiments would be the resultant of these two opposite factors. The value of this resultant may be positive (B') or negative (C') or the positive and negative coefficients may completely nullify each other (A').

All the three possible sets of circumstances are afforded by the data of Fan, Cheng & Glenn Richards (p. 51). They found the coefficient positive with 1:10 million concentration and negative with 1:500 million and 1:1000 million concentrations but no definite temperature effect was noticeable with 1:100 million concentration.

They also report that following injection the positive temperature coefficient is irrespective of concentration. It is impossible to explain this phenomenon satisfactorily at present but injection being far more drastic

than external application, even the lowest injected concentration may be acting as higher concentration applied externally.

Thus it is possible to explain all observations without presuming any fundamental reversal in the action or penetration of DDT when its concentration changes from high to low. It appears that temperature coefficient of DDT entry remains positive irrespective of concentration but its value decreases with decrease in concentration and gets masked by the temperature coefficient of insect's resistance when a negative temperature coefficient of DDT action begins to be observed in actual experiments.

Grateful thanks are due to the Director Dr. J. N. Mukherjee and Dr. C. Potter for helpful criticisms and to Dr. B. Chatterjee for help in incorporating Chemist's viewpoint.

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1. *Bull. Ent. Res.*, 40, 2, 239-65.
2. *Physiological Zoology*, 21, 1, 48-59.

*N.B.—Straight line relationship presumed for convenience only.

OCCURRENCE OF CHESTNUT-BLIGHT IN THE KUMAON HILLS

A SERIOUS bark disease of chestnut in the Government Gardens, Chaubattia, on examination was found to be chestnut-blight incited by *Endothia parasitica* (Murr.) And. & And. It was first noted in a mild form at this station by late Dr. U. B. Singh and in a severe form in December 1948 by the author when a chestnut tree, about 20 years old, died suddenly. Survey of chestnut plantation showed tree infection up to 75%, ranging from light to very severe attack. Most old trees showed typical symptoms of the disease, with main trunk dead and fresh sprouts arising from the base.

Symptoms.—The fungus attacks the bark first and later the soft wood. The infected area turns brownish and then completely girdles the branch. Gradually longitudinal cracks appear on the infected areas and the dead bark starts peeling off (Fig. 1).

Numerous orange coloured fruiting pustules appear on the bark and in the

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50% fat

(b) do

(c) do

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The trunk and main branches of a chestnut tree showing old and new cankers caused by

Endothia parasitica

revices. The pycnidia are erumpent, sessile, orange coloured papillae. The base of the pycnidium is usually convoluted and beset on the surface with small pycno-sporophores. The pycnosporophores measure $1.3\mu \times 3.3\mu$.

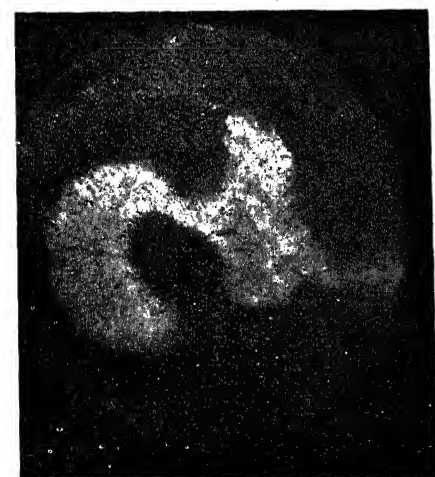


FIG. 2. Section of a pycnidium

Perithecial stromata develop from pycnidial pustules and are ostiolate. The perithecia are flask-shaped, black, deeply immersed in the host, measuring 360μ in diameter. They have long neck beset with numerous hairs (Fig. 3).



FIG. 3. Section of a perithecial stroma, showing the immersed long-necked perithecia with asci and ascospores.

The fungus grows readily on potato-dextrose agar and forms in about 5 days, orange coloured pycnidia from the apex of which slimy mass of pycnosporophores ooze out.

Thanks are due to Dr. A. K. Mitra, Plant Pathologist to Govt., U.P., for kind interest and suggestions.

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September 9, 1949.

S. L. GUPTA.

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3. —, Stevens, N. E., and Tiller, R. J., U. S. D. A., *Professional Bull.*, 1914, No. 380.
4. Heald, F. D., *Manual of Plant Diseases*, McGraw Hill Book Co., 1933, N. Y.

EFFECT OF CHOLINE AND METHIONINE ON THE EXPERIMENTALLY PRODUCED HEPATIC LESIONS IN RATS

IN view of the divergent opinions ^{1,2,3,4,5,6,7} on the value of choline and methionine in the prevention of cirrhosis of liver in rats the following study was undertaken, using both choline and methionine.

Procedure: Low protein (casein) and high fat diets were used for the production of hepatic lesions in rats. The diet-forms

and other details are summarised below in tabular form.

Diet (percentage of casein and fat given only)	Vitamin supplements per rat per day	Special supplements		No. of rats	Average initial weight in g.	Duration of experiment Days
		Choline mg. per rat per day	Methionine mg. per rat per day			
(a) 6% casein 50% fat	Thiamin 20 μ g Riboflavin 25 μ g Pyridoxine 20 μ g Calcium pantothenate 100 μ g	..	..	12	102	33-110
(b) do	do	4	..	12	98	32-124
(c) do	do	..	20	12	96	91-162
(d) 6% casein 30% fat	do	..	..	12	98	42-145
(e) do	do	8	..	12	97	63-168

Results: (a) Livers on macroscopic examination of most of the animals on 50% fat diet alone showed varying degrees of enlargement and were highly fatty. On microscopic examination, severe fatty infiltration was found in the liver in almost all the animals. Animals killed between 55 to 97 days showed diffuse hepatic fibrosis and, in some, typical cirrhosis with ceroid pigmentation was found. None of the animals, however, showed massive hepatic necrosis.

(b) In animals receiving 50% fat diet with 4 mg. of choline daily, the livers were fairly normal in size. The fatty change in the liver was much less marked in this group of rats as compared to the controls. Similarly, the fibrosis was also less marked and there was no ceroid pigment. It appears that daily supplement of 4 mg. of choline is not sufficient to completely prevent the fatty change and the subsequent liver injury.

(c) In animals receiving 20 mg. of methionine daily along with 50% fat diet, there was moderate fatty change in the liver with slight accumulation of ceroid pigment. Slight fibrosis around the central veins was also observed in a few animals.

(d) In animals receiving 30% fat diet without choline, the livers were enlarged,

pale and fatty. Histological examination of the liver showed typical heavy fatty infiltration, particularly around the central veins. Although ceroid pigment was occasionally noticed, no fibrosis was present.

(e) In animals receiving 8 mg. of choline supplement daily along with 30% fat diet, the livers were normal in size. On microscopic examination, fatty infiltration of the liver was not found in any of the animals of this group. There was no trace of ceroid pigment or fibrosis in any of the animals. Thus 8 mg. of choline supplement daily resulted in almost normal livers when the fat content of the diet was 30%.

The detailed results will be published elsewhere.

Our thanks are due to Major-General Sir Sahib Singh Sokhey, Director, Haffkine Institute, for his encouragement and keen interest in this investigation.

M. V. RADHAKRISHNA RAO.

N. C. DATTA.

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Department of Nutrition and
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Bombay,
September 14, 1949.

1. Blumberg, H., and McCollum, E. V., *Sci.*, 1941, **93**, 598. 2. Daft, F. S., Sebrell, W. H., and Lillie, R. D., *Proc. Soc. Expt. Biol. and Med.*, 1941, **48**, 228. 3. Engel, R. W., *Federation Proc.*, 1943, **2**, 62. 4. Gyorgy, P., Poling, E. C., and Goldblatt, H., *Proc. Soc. Expt. Biol. and Med.*, 1941, **47**, 41. 5. — and Goldblatt, H., *Ibid.*, 1941, **46**, 492. 6. —, *Am. Journ. Clin. Path.*, 1944, **14**, 67. 7. Himsworth, H. P., and Glynn, L. E., *Clin. Sci.*, 1944, **5**, 93-123.

FLUORESCENT INDICATORS FOR ACID-BASE TITRATIONS—PART II

THE remarkable fluorescence of the coumarins has been frequently noted¹ but only a few have been used as fluorescent indicators.^{2,3,4,5} A large number of coumarins synthesised by Seshadri, *et al.* were available to us and since these had not been examined previously, the present authors investigated their fluorescence changes with change in pH under filtered, U.V. light from the "Technico" U.V. Analytical Lamp supplied by Messrs. Gallenkamp, London. Buffer solutions of known pH were prepared using Universal Buffer Mixture supplied by Messrs.



FIG. 1. The trunk and main branches of a chestnut tree showing old and new cankers caused by *Endothia parasitica*

deep crevices. The pycnidia are erumpent, as raised orange coloured papillæ. The cavity of the pycnidium is usually continuous, convoluted and beset on the surface with small pycno-sporophores. The pycno-spores measure $1.3\mu \times 3.3\mu$.

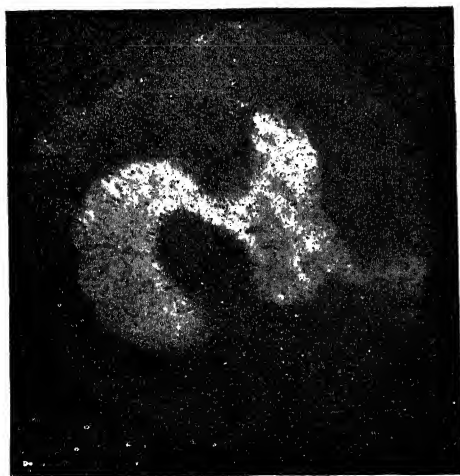


FIG. 2. Section of a pycnidium

Perithecial stromata develop from pycnidial pustules and are ostiolate. The perithecia are flask-shaped, black, deeply immersed in the host, measuring 360μ in diameter. They have long neck beset with numerous hairs (Fig. 3).



FIG. 3. Section of a perithecial stroma, showing the immersed long-necked perithecia with asci and ascospores.

The fungus grows readily on potato-dextrose agar and forms in about 5 days, orange coloured pycnidia from the apex of which slimy mass of pycnospores ooze out.

Thanks are due to Dr. A. K. Mitra, Plant Pathologist to Govt., U.P., for kind interest and suggestions.

Section of Mycology,
Govt. Hill Fruit Res. Station,
Chaubattia, U.P.,
September 9, 1949.

S. L. GUPTA.

1. Anderson, P. J., and Anderson, H. W., *Phytopathology*, 1912, 2, 204-10. 2. Shear, C. L., U. S. D. A. Bur. of Plant Industry Cir., 1913, 131-A. 3. —, Stevens, N. E., and Tiller, R. J., U. S. D. A., *Professional Bull.*, 1914, No. 380. 4. Heald, F. D., *Manual of Plant Diseases*, Mc Graw Hill Book Co., 1933, N. Y.

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M. V. RADHAKRISHNA RAO.

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Department of Nutrition and
Experimental Pathology,
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September 14, 1949.

1. Blumberg, H., and McCollum, E. V., *Sci.*, 1941, **93**, 598. 2. Daft, F. S., Sebrell, W. H., and Lillie, R. D., *Proc. Soc. Expt. Biol. and Med.*, 1941, **48**, 228. 3. Engel, R. W., *Federation Proc.*, 1943, **2**, 62. 4. Gyorgy, P., Poling, E. C., and Goldblatt, H., *Proc. Soc. Expt. Biol. and Med.*, 1941, **47**, 41. 5. — and Goldblatt, H., *Ibid.*, 1941, **46**, 492. 6. —, *Am. Journ. Clin. Path.*, 1944, **14**, 67. 7. Himsworth, H. P., and Glynn, L. E., *Clin. Sci.*, 1944, **5**, 93-123.

FLUORESCENT INDICATORS FOR ACID-BASE TITRATIONS—PART II

THE remarkable fluorescence of the coumarins has been frequently noted¹ but only a few have been used as fluorescent indicators.^{2,3,4,5} A large number of coumarins synthesised by Seshadri, *et al.* were available to us and since these had not been examined previously, the present authors investigated their fluorescence changes with change in pH under filtered, U.V. light from the "Technico" U.V. Analytical Lamp supplied by Messrs. Gallenkamp, London. Buffer solutions of known pH were prepared using Universal Buffer Mixture supplied by Messrs.

S. No.	Indicator	Colour change	pH range	Remarks
1	8-Allyl umbelliferone	Pale blue to blue	7.1-8.1	The solution is turbid at 7.1 and clear at 8.1
2	3-Acetyl-5-methyl umbelliferone	Blue to green	5.1-7.1	Solution is yellow
3	5: 7-Dihydroxy-4-methyl-coumarin-3-acetic acid	Blue to bluish green	6.1-7.1	In alkaline solution yellow
4	7: 8-Dihydroxy-4-methyl-3-acetic ester	Indistinct changes	4.1-6.1	..
5	5-Hydroxy-4: 7-dimethyl coumarin	..	7.1-8.1	Turbidity in acid solution
6	3-Phenyl umbelliferone	Blue to green	6.1-7.1	Alcoholic solution is bright blue in fluorescence both in daylight and U.V.
7	8-Allyl-4-methyl umbelliferone	Blue to deep blue	3.1-8.1	Alcoholic solution is blue fluorescent only in U.V.
8	7-Methoxy-3-phenyl coumarin	No prominent changes	3.1-10.1	Alcoholic solution fluoresces violet in daylight and deep blue in U.V.
9	7-Methoxy-4 methyl coumarin	..	..	Acid: pale violet; Alkali: pale blue in U.V.
10	5-Methoxy 4: 7-dimethyl-coumarin-3-acetic acid	..	..	Acid: nil; Alkali: pale blue in U.V.
11	5: 7-Dimethoxy-4 methyl coumarin-3-acetic acid	..	..	Acid: yellow; Alkali: blue in U.V.
12	7 Methyl coumarin	..	..	Acid: nil; Alkali: yellow in U.V.
13	4: 7-Dimethyl coumarin	..	..	Acid: nil; Alkali: pale blue in U.V.
14	5-Methoxy-4: 7-dimethyl coumarin	..	..	Acid: pale yellow; Alkali: pale blue in U.V.
15	8-Methoxy coumarin	..	..	Acid: nil; Alkali: nil in U.V.
16	3-Acetyl-7-methoxy coumarin	..	..	Acid and alkali light blue in U.V. No prominent difference

The British Drug House. The acid and alkali under 'Remarks' are 2N bunch reagents. Quartz test-tubes were employed in all tests. A few drops of very dilute alcoholic solution of the indicators were used in each case.

It is seen from the above table that all the compounds (1 to 7) with a free hydroxyl in position 7 as in umbelliferone yield promising results. On the other hand, coumarins without a free hydroxyl (8 to 16) as a class do not yield prominent changes in fluorescence with changing pH. These observations support Jensen's⁴ conclusion that coumarins act as indicators only when a free hydroxyl is present in the molecule.

Grateful thanks are due to Prof. T. R. Seshadri for placing at our disposal the large number of synthetic samples.

Andhra University, K. NEELAKANTAM.
Waltair, G. VISWANATH.
November 18, 1949.

1. Seshadri, *et. al.*, *Proc. Ind. Acad. Sci.*, 1940, 12A, 375; *Ibid.*, 1941, 13A, 316; *Ibid.*, 1942, 16A, 68. 2. Radley and Grant, "Fluorescence Analysis in Ultra-Violet Light," 1939, 3rd edition. 3. Deribere, *Ann. Chim. analyt.*, 1936, (iii), 18, 37. 4. Jensen, *Zeit. anal. Chem.*, 1939, 117, 50; *C. A.*, 1940, 34, 320. 5. Shah and Dave, *Curr. Sci.*, 1949, 18, 381.

EXTENSION OF THE MAESTRICHTIAN SEA INTO THE PUNJAB SALT RANGE

In the Mesozoic sequence of the Salt Range, beds younger than the Neocomian have not hitherto been recognised and it is believed¹ that towards the latter part of the Cretaceous, uplift resulted in a considerable recession of the Tethys to the west. Micro-palaeontological examination of collections made by us in 1946 from the Nammal Gorge (32° 40': 71° 48'), indicates that the Ranikot beds (Palaeocene) are underlain by a bed of foraminiferal limestone containing the well-known Upper Cretaceous genera *Globotruncana* and *Omphalocyclus*. From this evidence, it is concluded that an arm of the Maestrichtian sea which covered Sind and Baluchistan must have extended well into the Salt Range upto about longitude 72°.

In his recent account of the geology of the Salt Range, Dr. E. R. Gee² has, on lithological considerations, classified the Jurassic-Cretaceous sequence at Kalabagh (32° 58': 71° 33'), the western limit of the Salt Range, as follows:—

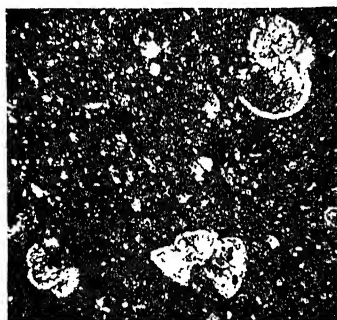
Palaeocene	Ranikot beds with laterite at base
L. Cretaceous	{ Lumshiwal sandstones
Upper Jurassic	{ Belemnite beds
	{ Baroch limestones
Jurassic	{ Variegated stage

He has further pointed out that the Mesozoic beds thin south-eastwards along the range with gaps in the sequence and at Nammal gorge, the Lumshiwal sandstones and Belemnite shales have not been deposited and the Baroch limestones are succeeded by the Ranikot beds. No Mesozoic beds have been recorded east of longitude 72°.

The Upper Cretaceous foraminifera we are now recording are from the Baroch limestones of the Nammal gorge which Dr. Gee has classified as Jurassic. The upper part of the gorge from which our collections were made is shown in the accompanying photo. The sequence seen is as follows: (a) Khairabad limestones; (b) Dhak Pass beds; (c) Baroch limestones; (d) Kingriali dolomites.



View of the upper part of the Nammal gorge showing the following sequence: (a) Khairabad lst., (b) Dhak Pass beds, (c) Baroch lst., (d) Kingriali dolomites. (Photo: S. C. Sah).



Globotruncana rosetta and *Globigerina* sp. $\times 46$. Baroch lst., Nammal Gorge.

In thin sections of the limestone the forms frequently seen are the pelagic genera *Globotruncana* and *Globigerina*. The value of the genus *Globotruncana* for the recognition and correlation of the Upper Cretaceous throughout the world is now widely recognised^{3,4,5} and *G. rosetta*, the species seen in the Baroch limestones is, in other parts of the world, confined

to the Campanian-Mæstrichtian. The other foraminifera recognised are: *Lenticulina* sp., *Textularia* sp., and *Nodosaria* sp. One of the sections contains a fragment of the orbitoid *Omphalocyclus macropora* which furnishes critical evidence for a Mæstrichtian age.

From the above, it is obvious that the Lumshiwal standstones and Belemnite beds which intervene between the Ranikot beds and the Baroch limestones at Kalabagh should also be late Cretaceous in age.

Dept. of Geology, S. R. NARAYANA RAO.
University of Lucknow, B. TRIPATHI.
Lucknow,
November 8, 1949.

1. Gee, *Proc. Nat. Acad. Sci.*, 1944, **14**. 2. —, *Ibid.*, 1946, **16**. 3. Glaessner, "Studies in Micropalaentology" (Moscow, 1937). 4. Thalmann, *Ecol. Geol. Helvet*, 1934, **27**. 5. Renz, *ibid.*, 1936, **29**.

RANDOM ASSOCIATION OF POINTS ON A LATTICE

THE author has recently (1948 and 1950) discussed a number of distributions arising from mn points possessing one of k characters with probabilities p_1, p_2, \dots, p_k , arranged in the form of a lattice of m columns and n rows. It was not possible to give earlier the third and the fourth cumulants for the distribution of the total number of joins taken along mutually perpendicular axes between points of varying characters. The present note gives the third and the fourth cumulants of this distribution.

$$\begin{aligned}\kappa_3 &= 2(32b - 37a + 36)a_2 + 4(111b - 147a \\ &\quad + 157)a_3 + 24(22b - 31a + 36)a_4 - 24 \\ &\quad (30b - 37a + 38)a_2^2 - 48(15b - 20a + \\ &\quad 22)a_2a_3 + 64(29b - 37a + 39)a_2^3. \\ \kappa_4 &= 2(128b - 175a + 220)a_2 \\ &\quad + 4(1041b - 1635a + 2292)a_3 \\ &\quad + 24(557b - 938a + 1408)a_4 \\ &\quad - 4(1784b - 2617a + 3476)a_2^2 \\ &\quad + 120(87b - 156a + 244)a_5 \\ &\quad - 24(1983b - 3252b + 4788)a_2a_3 \\ &\quad + 32(1548b - 2361b + 3228)a_2^3 \\ &\quad - 192(282b - 477b + 712)a_4a_2 \\ &\quad - 864(31b - 52a + 77)a_3^2 \\ &\quad + 192(867b - 1404a + 2016)a_2^2a_3 \\ &\quad - 32(3126b - 4899a + 6828)a_2^4\end{aligned}$$

In the above expression, a and b stand for $m+n$ and mn respectively, while

a_2, a_3, a_4 and a_5 are the usual monomial symmetric functions in $p_1, p_2, p_3, \dots, p_k$, viz., $(1^2), (1^3), (1^4)$, and (1^5) .

The above cumulants are linear expressions in a and b . The first and the second cumulants given in the previous papers are also linear in a and b . Hence γ_1 and γ_2 tend to zero when m and n tend to infinity. Therefore, when m and n tend to infinity, the distribution tends to the normal form.

Full details will be published in the *Journal of the Society of Agricultural Statistics*.

Indian Council of P. V. KRISHNA IYER.
Agricultural Research,
New Delhi,
November 12, 1949.

1. Krishna Iyer, P. V., *Nature*, 1947, 160, 714.
2. —, *Ann. Math. Stat.*, 1950 (in the Press).

NUTRITIVE VALUE OF DUCK EGG WHITE

THE rachitogenic diet of Schneider and Steenbock (1939) in which hen egg white is the only source of protein, can sustain a fair degree of growth in rats, while inducing severe rickets in them within 2 to 3 weeks (Dikshit and Patwardhan, 1947). When duck egg white was substituted in the above ration, marked growth inhibition was noted in the animals together with the complete absence of any signs of rickets as shown in Table I.

TABLE I

Source of protein	Protein %	Ca/P	No. of Rats	Wt. in gm. (Average)			Days on diet	Degree of rickets	Bone ash % (Average)
				Initial	Final	Diff.			
Hen egg White	16.1	23.8	6	52	60	+8	14	++++	29.7
Duck egg White	17.1	23.5	6	52	44	-8	14	Nil	39.0

Since the predisposing factor for the production of rickets on a rachitogenic diet is continued growth, it was felt that lack of growth observed in the animals on duck egg white was probably responsible for the absence of rickets in them. An explana-

tion was, however, warranted for the inhibition of growth in the young animals on duck egg white. Two possibilities that suggested themselves were: (i) the poor nutritive quality of the duck egg white, and/or (ii) the presence of some toxic factor.

To decide the issue rats were kept on synthetic diets containing different levels of duck egg white protein. Control animals were kept on comparable levels of hen egg white protein. It was observed that on diets containing 8.4 and 15.5 per cent. duck egg white protein the average weight increase over eight weeks was 21 gm. and 41 gm. respectively whereas on hen egg white protein diets the increase was 65 gm. and 68 gm. respectively during the same period. The difference in food intake on the two diets was negligible. This experiment thus showed that the growth retardation or inhibition in rats on duck egg white could not be due to the presence of a toxic factor, since if such was the case, increased amounts of duck egg white in the diet would have caused a more pronounced adverse effect on growth than was seen at the lower levels.

The obvious inference that could be drawn was that the duck egg white protein had a lower nutritive value than the hen egg white protein on account of its (i) lower digestibility, and/or (ii) deficiency of one or more essential amino acids.

A few metabolic experiments were carried out on growing rats using the duck and hen egg white protein diets, to compare their respective digestibilities. The results showed that rats fed duck egg white excreted in faeces about 4 times as much nitrogen as the animals fed hen egg white diets at comparable levels of protein intake. The urinary nitrogen excretion was, on the other hand, considerably more in the animals fed the latter diets. In short, the duck egg white protein appeared to be much less absorbed by the rats than the hen egg counterpart.

These observations clearly show that the duck egg white has a lower nutritive value than hen egg white, the cause of which may be the low digestibility of the former. Further work is in progress and fuller details will be published elsewhere.

One of us (P.K.D.) wishes to express his grateful thanks to the Raptakos Medical

Research Board for the award of a Fellowship.

P. K. DIKSHIT.

V. N. PATWARDHAN.

Nutrition Research Laboratories,
Indian Research Fund Assn.,
Coonoor, South India,
November 30, 1949.

1. Schneider, H., and Steenbock, H., *Jour. Biol. Chem.*, 1939, 128, 159. 2. Dikshit, P.K., and Patwardhan, V.N., *Ind. Jour. Med. Res.*, 1947, 35, 91.

CHEMICAL EXAMINATION OF KARLA PLANTS

FATTY oils from *Karla* seeds (*Memordica Charantia* and *Memordica dioica*, N.O. *Cucurbitaceae*) develop rancidity fairly quickly converting themselves into a powdery form; this form changes once again to a liquid state when allowed to stand for nearly 3-4 months, or when autoclaved for one hour at 120° C. under a pressure of 15 lbs. This phenomenon and the glyceride structure of the oils are now being studied.

Their seed cakes (after petroleum ether extraction for the oils) were extracted successively with benzene, chloroform and alcohol. The alcohol extract yielded a white solid, m.p. 236° C. (uncorrect) giving colour reactions for alkaloid. It was crystallized from water.

After extraction with these solvents a water soluble and saline soluble protein was extracted from the cake. On heating the aqueous extract, the protein coagulated and became "denatured". It contains nitrogen, 14.5% and sulphur, .967%. It shows the presence of methionine estimated according to Horne Jones and Blum (*J. Biol. Chem.*, 1946, 166, 313) and of cystine estimated according to Callan and Toennies (*Ind. and Eng. Chem. Anal. Ed.*, 1941, 13, 450).

After the removal of these proteins, the seed cake residue was extracted with hydrochloric acid and the acid extract neutralized with ammonia. A white solid separated out which was washed with alcohol, chloroform and ethyl acetate, successively. On ignition it suffered a loss in weight to the extent of 45.5%, the residue consisting of aluminium and magnesium.

Details of this investigation will be published later elsewhere.

Rajaram College,
Kolhapur,
April 15, 1949.

J. W. AIRAN.
N. D. GHATGE.

ANALYSIS OF ANCIENT GLASS BEADS

THE beads are from the site of Arikamedu, near Pondicherry.¹ On the basis of the red glazed pottery (Arretine ware) and of the two-handled jars (amphoræ) found on the site and from literary evidence, the period has been fixed as the first century A.D.

The beads were dull blue approaching indigo and almost opaque. The specific gravity of the glass was 2.53. Microscopic examination of thin flakes (120×) showed the presence of numerous tiny air bubbles due to imperfect fusion. The opacity of the glass may be due to these tiny air bubbles.²

The composition of the glass expressed as percentages is:—

SiO₂-73.6, Al₂O₃-1.9, FeO-2.0, Fe₂O₃-1.1, CaO-3.9, MgO-1.4, K₂O-13.4, Na₂O-2.1, MnO*-0.4, Total 99.8.

The data shows that the glass is essentially a potash-lime-silicate. The alkali being largely potash, suggests that plant ash must have been used.

The colour of the glass is due to iron. The sample is free from copper and cobalt. The usual colours due to iron are green and yellow the former corresponding to the ferrous and the latter to the ferric state. That iron can impart blue colour also was first discovered by Gmelin more than 150 years back. Other cases have also been recorded in which the blue colour of the glass had been due to iron compounds.³ Some blue Chinese glazes are also said to owe their colours to ferrous oxide.⁴ Bancroft and Cunningham⁵ are of the opinion that the blue colour is due to an unstable modification of ferric oxide which is stabilised chiefly by ferrous oxide but to some extent by other substances. In this connection the presence of both ferrous and ferric iron in the bead is significant. The ratio of ferrous to ferric in this case is 1.82, which is not the optimum ratio advocated by the above authors in the case of borate glasses. But as they themselves point out "the ratio of ferrous oxide to ferric oxide necessary for a good blue may be quite different in a silicate glass from what it is in a borate glass." Moreover there is the question of "other components".

The manganese must have been an impurity of the quartz used as raw material. The bluish violet colour which manganese imparts to potash glass must also have helped to give the final shade of colour.

The author's thanks are due to Dr. A. Aiyappan, Superintendent of the Madras Government Museum, and to Mr. C. J. Jayadev, M.A.,

Curator, Anthropology Section for their keen interest in the work.

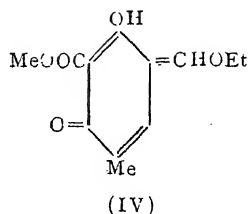
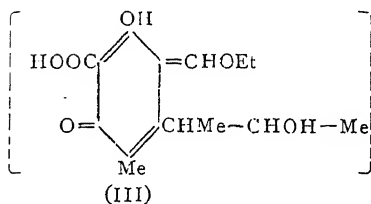
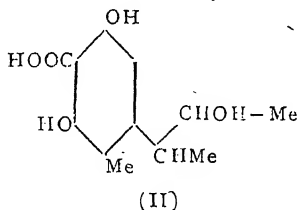
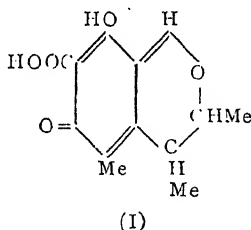
Chemical Laboratory, R. SUBRAMANIAN,
Govt. Museum, Madras,
December 31, 1949.

* Manganese is reported as MnO; it need not necessarily be in that form.

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A NEW PARTIAL SYNTHESIS OF CITRININ

Two partial syntheses of citrinin (I) and its methyl ester, starting from "Product A" (the phenol produced by acid or alkaline hydrolysis of citrinin), have been described so far.^{1,2} In one, due to Robertson, *et al.*,¹ the acid (II; prepared by carboxylation of Product A) or its methyl ester is submitted



to the Gattermann aldehyde synthesis and then, in a second step, cyclized with sulphuric acid; a yield of 33% is claimed.¹ Warren, *et al.*, heat (II) with methylal and benzene saturated with dry hydrogen chloride in a sealed tube at 60° for six hours; dihydrocitrinin is thus obtained and is oxidized to citrinin by bromine in chloroform.² A much simpler synthesis, which has interesting possibilities for synthesis in the isochromane series, has now been achieved. When (II) is treated at room temperature (28-30° C.) with about ten times its weight of ethyl orthoformate, a crystalline precipitate of citrinin separates rapidly from the yellow solution. After thirty minutes, crushed ice is added and the yellow needles of citrinin filtered, washed and dried. The m.p. (171.5°, dec.) is undepressed by admixture with natural citrinin, and the yield is nearly quantitative. The reaction apparently proceeds through the ethoxymethylene derivative (III), since a compound (IV) of this type is formed by the action of ethyl orthoformate, acetic anhydride and zinc chloride on the methyl ester of 4-methylresorcinol-2-carboxylic acid.

The behaviour of citrinin towards diazonium salts has now been completely elucidated.³ In referring to our earlier note on the subject⁴ and their own failure to isolate and characterize the products of the interaction of citrinin with diazonium salts, Robertson, *et al.*, have misrepresented the evidence on which we demonstrated the incorrectness of the structure assigned to citrinin by Coyne, Raistrick and Robinson;⁵ the fact that Product A, as well as the methylethylresorcinol produced by alkali fusion of Product A, gave disazo dyes proved conclusively that the alkyl groups could not be in the 2:4-positions of resorcinol, and citrinin therefore could not possess the constitution which was accepted for many years.⁶

We are indebted to the Council of Scientific and Industrial Research for a grant.

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December 7, 1949.

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GROWTH-PROMOTING FACTORS IN CORN GERM EXTRACT

THE potentiality of the corn germ extract for promoting growth of immature corn embryos in the culture medium is examined in this report.

Corn germ extract was compared against cocoanut water in their effects on embryo growth in corn since the latter was found to exercise some growth-promoting effect on a young corn embryo in a previous investigation of the author (²Uttaman, 1949). From this it also became clear that the embryo growth would perhaps be more clearly manifested if the extract was applied at the germinal stage. Bearing this in mind, in the present experiment the following treatments were laid out:

1. Aqueous extract of corn germ applied to Tukey's general purpose medium on the next day of placing the embryo in the medium.
2. Cocoanut water applied to the above medium on the next day of placing the embryo in the medium.
3. Control-Corn embryos placed in Tukey's general purpose medium without application of corn germ extract or cocoanut water.

Nine embryos of corn, each two-week-old were used in this experiment. The usual anti-septic precautions were adopted in the preparation of the extract of the germs ex-

cised out of the sprouting corn seeds. The extract was in the end Seitz-filtered under vacuum pressure as a measure against bacterial contaminations since the natural extracts are not usually stable to autoclaving. They were kept in one ounce bottles containing Tukey's general purpose medium (¹Uttaman, 1949) to which no physiologically active substances were added. The bottles were kept inside an incubator at $31^{\circ} \pm 1^{\circ}$ C. with one embryo in each, holding equal amount of the medium. Each treatment was thus repeated three times. Growth measurements for shoot and root were made contiguously for five days for the same embryo. The embryos were placed in the medium on September 12, 1947 and the extracts applied daily beginning on the next day. The results are entered in the table below:

Replication	Days of measurement	Extract of corn germ applied on 13-9-47		Cocoanut water applied on 13-9-47		Control	
		Shoot mm.	Root mm.	Shoot mm.	Root mm.	Shoot mm.	Root mm.
I	1st day	3.7	1.7	1.7	Nil	3.6	Nil
	2nd "	8.0	3.2	2.6	Nil	5.8	Nil
	3rd "	11.5	4.9	6.0	Nil	6.8	Nil
	4th "	18.1	4.9	6.0	Nil	7.2	Nil
	5th "	20.0	4.9	6.0	Nil	7.9	Nil
II	1st "	1.2	Nil	2.2	Nil	2.1	Nil
	2nd "	2.6	Nil	3.5	Nil	3.8	Nil
	3rd "	3.3	Nil	5.6	Nil	4.4	Nil
	4th "	4.5	Nil	5.6	Nil	4.8	Nil
	5th "	5.4	Nil	5.6	Nil	5.5	Nil
III	1st "	2.8	Nil	1.9	Nil	2.7	Nil
	2nd "	3.9	Nil	2.9	Nil	2.9	Nil
	3rd "	5.3	Nil	4.3	Nil	3.7	Nil
	4th "	7.9	0.2	4.3	Nil	4.5	Nil
	5th "	8.2	0.5	4.3	Nil	4.7	Nil

From the table it will be seen that the effect of the corn germ extract on the growth of the embryo is more marked than that of the cocoanut water and is of a more progressive character. This is particularly noticeable in the case of the second replication. In spite of the fact that the initial size of the shoot in this was only 1.2 mm., being only half as long as that treated with cocoanut water in the second replication, it was able to make up this difference in size within a short period of four days. The depressing effect of the cocoanut water is also very noticeable. The results confirm

the findings of previous workers (Haagen-Smit, 1945) that the growth factors in coconut water are different from those derived from the corn kernel.

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A MOSAIC DISEASE OF SUNN HEMP IN BOMBAY

THE virus causing mosaic disease in sunn hemp (*Crotalaria juncea* L.) was found in November 1940, on some plants in an experimental plot cultivated for raising seeds of the wilt resistant variety at the Agricultural College Farm, Poona. The disease appeared during three consecutive seasons among plants grown in the same plot and from seeds collected from the diseased crop in the previous season.

Symptoms.—The disease appears as distinct mosaic mottling on younger leaves in about 9 days following sap inoculation of plants. The inoculated leaves do not display any disease symptoms. As the infected plants grow the leaves, which are reduced in size and slightly malformed, develop puckering in the form of raised blister-like green areas alternating with light green areas. Occasionally thin elongated enations are also formed on the under side of leaves. Affected plants are dwarfed and produce poor seed.

The virus.—The virus is readily transmitted on inoculation with infective sap by the leaf rubbing method. It retains infectivity at a dilution of 1×10^{-5} , withstands heating for 10 minutes at 90° C. and in an undiluted crude sap was still infective after storage for 557 days. The virus also withstands contact with 90 per cent. ethyl alcohol for 24 hours. So far no insect vector of the virus has been found.

Host range.—In addition to sunn hemp, the virus is infectious to *Crotalaria retusa*, *C. striata*, *C. lanceolata*, *C. spectabilis*, *C. laburnifolia*, *C. usaramoensis*, *Lathyrus sativus*, *Phaseolus vulgaris*, *P. lunatus*, *Vigna unguiculata* and *V. sesquipedalis*. It causes formation of only local

lesions in *Nicotiana glutinosa*, *N. sylvestris*, *Datura stramonium* and *Capsicum frutescens*. The virus did not infect *Dolichos lablab*, *Solanum nodiflorum*, *Datura alba* and tobacco amongst many others which were inoculated with infective sap. Cowpea (*Vigna sinensis*) and tomato supported virus multiplication in them without developing any symptoms of the disease.

Crotalaria mosaic has been reported in the past from Poerto Rico^{1,2} Hawaii,³ Japan,⁴ Malaya,⁵ China,⁶ United States⁷ and Trinidad.⁸ The disease dealt with in this note is the second record of a mosaic virus affecting sunn hemp in India, since a mosaic disease of *Crotalaria juncea* has been reported from Delhi in 1947.^{9,10} Though the disease occurring in Bombay resembles that reported from Delhi⁹ in its symptom expression, it is quite distinct from the latter in respect of its physical properties and host range. Accordingly, this virus has been designated as 'southern sunn hemp mosaic' virus in order to distinguish it from that occurring in North India.

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CATALASE RATIO AS A RAPID METHOD FOR DETERMINING THE GERMINATING CAPACITY OF SEEDS

ATTEMPTS have been made in recent years to evolve a rapid and reliable method for testing the viability of seeds. The investigations of 'Nemec and Duchon,² Davis,¹ and Singh, et al.⁴ reveal the close correlation between the catalase activity and the germinating capacity of the seeds.

The response of seeds and seedlings of varying biochemical constitution to hormone treatment shows that the catalase ratio (ratio of the catalase activity of the soaked

seeds over that of dry seeds) and the germinating capacity of seeds are affected by varying concentrations of hormone treatment. The results of the above studies are of practical interest in that the method can be used for determining rapidly the viability of the seeds. A brief report of the same is made here.

Graded seeds of maize (*Zea mays*, var. Jaunpur yellow), wheat (*Triticum vulgare* var. I.P. 52), bean (*Phaseolus vulgaris*, var. Banaras local) and safflower (*Carthamus tinctorius*, var. Banaras local), were sterilized by keeping with 0.25% solution of

to further establish the relationship between the catalase ratio and the germinating capacity, 'correlation coefficients' were worked out from the compiled data separately for all the crop seeds and the quantitative relationship was determined by working out the regression of germinating capacity on catalase ratio separately for each crop.

The values for the 'coefficient of correlation' are +0.987, +0.876, +0.986 and +0.998 for maize, wheat, bean and safflower respectively. These suggest that a high positive correlation exists between the catalase ratio and germinating capacity.

TABLE I

Treatment (mg. of phenyl propionic acid per litre)	Maize			Wheat			Bean			Safflower		
	Germination %			Germination %			Germination %			Germination %		
	Catalase ratio	Observed	Calculated from regression equation	Catalase ratio	Observed	Calculated from regression equation	Catalase ratio	Observed	Calculated from regression equation	Catalase ratio	Observed	Calculated from regression equation
(1) Control (0 mg.)	2.3	65.5	62.3	2.3	70.0	71.6	1.5	58.5	55.5	2.0	60.5	60.0
(2) 1 mg.	2.4	72.0	64.7	2.2	69.0	68.8	2.4	78.0	86.1	2.1	62.0	62.2
(3) 10 mg.	3.1	80.0	81.2	2.1	67.0	66.1	1.7	60.0	57.9	2.2	64.1	64.4
(4) 50 mg.	3.3	85.5	86.0	2.1	66.5	66.1	1.5	57.5	55.5	2.3	66.0	66.6
(5) 100 mg.	3.0	75.0	78.9	1.8	65.0	57.8	0.5	20.5	21.4	2.9	80.0	79.9
(6) 300 mg.	0.2	7.5	12.6	0.3	9.5	16.4	0.2	7.5	11.2	2.5	71.5	71.1

uspulum for 20 minutes, and then washed twice for five minutes to remove the chemical and subjected to various concentrations of phenyl propionic acid for 18 hours as shown in Table I.

Germination counts were made at regular intervals of six hours and their percentage capacity computed. Catalase ratio was determined by dividing the catalase activity of the seeds under treatment by that of dry seeds. The manometer described by Singh and Mathur,³ was employed for simultaneous determinations of oxygen evolved from both dry and treated seeds. The results of the experiment are given in Table I.

The results show a close parallelism between the catalase ratio and germinating capacity of seeds. Thus a higher value of the catalase ratio in all the different seeds is accompanied by a higher percentage of their germination and *vice versa*. In order

The regression equations calculated in each case are:

(a) Maize: $Y = 7.94 + 23.660X$

(b) Wheat: $Y = 8.15 + 27.599X$

(c) Bean: $Y = 4.43 + 34.100X$

(d) Safflower: $Y = 15.90 + 22.085X$

Y = Germination percentage;

X = Catalase ratio.

The values for germinating capacity in each case have been calculated out from the corresponding regression equation and are presented in the table.

It is quite evident that although the catalase ratio and germinating capacity are affected similarly, the gross effects of varying concentrations of phenyl propionic acid vary from seed to seed. Thus in the case of maize the optimum effect is produced by 50 mg. per litre of phenyl propionic acid, in wheat by 0 mg.; in bean by 1 mg. and in safflower by 100 mg. of hormone per litre. These variations are probably due to vary-

ing physiogenetical constitution of these seeds.

My thanks are due to Dr. R. S. Choudhuri, Professor of Agricultural Botany, College of Agriculture, Benaras Hindu University, and Dr. J. J. Chinoy, Reader in Botany, University of Delhi, for their valuable suggestions and criticisms.

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PHOTOPERIODIC TREATMENT AND NITROGEN UPTAKE IN WHEAT

DIFFERENTIAL varieties response of wheat,^{10,12} barley,^{7,8} corn¹¹ and cotton^{5,6} to mineral nutrients is known. Correlations between growth and development of wheat and its photo-requirement reported elsewhere^{1,2,3,4} may prove useful in elucidating the problem of varietal response. With this in view, the effect of photoperiodic treatment on nitro-

TABLE I.

The ratio of N-content of stem and N-contents of leaf under different light treatments

Time days from sowing	Photoperiodic treatment		
	SD	ND	LD
51	..	..	0.70
58	..	..	0.71
65	0.42	0.43	0.72
72	0.22	0.42	0.93
79	0.33	0.44	1.30
86	0.38	0.38	1.34
93	0.51	0.47	1.90
100	0.39	0.74	1.89
107	0.34	0.67	2.37
114	0.76	0.98	1.64
121	0.71	0.99	..
128	..	..	..
135	1.85	1.24	..
Vegetative period (days)	109	99	78

gen uptake has been studied and the results throw some light on the varietal response of wheat.

Percentage Nitrogen content of leaves decreases rapidly with successive samples under normal day (ND) and is finally lower than those under longday (LD) and shortday (SD) treatments. It remains high in SD, probably because rapid utilization is hindered by low carbon assimilation. Table I shows interesting differences in nitrogen distribution in stem and leaf.

The ratio in SD and ND treatments increases suddenly at the time of flowering (anthesis) and is maintained at a high level. In the LD treatment, it is high from the very beginning. This increase in stem nitrogen shows that stem growth has reached its maximum at flowering and that a large portion of this increased stem N is ultimately translocated to the ear and utilised in grain formation. This is proved by the increased ear nitrogen corresponding to a decreased stem nitrogen. As the nitrogen of the ear is ultimately derived from the leaf, the leaf N decreases more rapidly than that of the stem and thus a high-level ratio is maintained.

Wheat varieties of different flowering classes have different inherent growth patterns, and when placed under different vernalization and photoperiodic treatments, the pattern changes with alteration in flowering time. An early rise in stem N under LD treatment, has greater significance as a similar early rise in stem N of early varieties is also observed.

A new orientation to concept of mineral nutrition in plants is given by Gregory⁹ in his "Internal Starvation" stage which marks the maximum in nutrient uptake rate and cessation of exponential growth in leaf area and dry weight increase. It supervenes even under high level nutrition and appears to bear some relation to onset reproductive phase.

Our findings support this view. The nitrogen uptake and distribution in wheat under different light treatments can be made to resemble that occurring in early and late varieties. A suggestion is made that the regulatory mechanism which puts an early check on tiller production and leaf dry weight increase in LD plants and in early flowering varieties also controls the nitro-

gen uptake and its early translocation to stem.

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SPAWNING HABITS AND DEVELOPMENT OF THE GANGETIC ANCHOVY, *SETIPINNA PHASA* (HAMILTON)*

LITTLE is known of the life history of the *phasa* fish of Bengal, *Setipinna phasa* (Hamilton) (= *Engraulis telera*), except the descriptions given by Nair¹ of the post-larvæ from 14 mm. to 50 mm., with special reference to the anterior shifting of the anus and the dorsal fin during the larval development. The breeding habits and development of *S. phasa* were worked out in the course of an investigation on the biology of *hilsa*, *Hilsa ilisha* (Hamilton), and a general study of the fish eggs and larvæ of the Hooghly estuary.

The observations were carried out mainly near Pulta (Barrackpore) from September to December, 1949. The pH of the water ranged from 8 to 8.3 and the salinity 6 to 10 p.p.m. As evinced by the collection of newly laid eggs both during the high tide and the low tide from various points in the river, the fish breeds along a considerable distance above and below Pulta, and spawning takes place in the evening from about 7 p.m. to 10 p.m. The incubation period varies from about 24 to 30 hours at an average water temperature of 28.6° C. The egg is pelagic, transparent and round, with a diameter of 0.95 mm. to 1 mm. and has several oil globules at the time of oviposition, which subsequently coalesce to form a conspicuously large single globule in 2 to 4 hours. The yolk is segmented as in typical clupeid eggs. The hatch-

ing takes place on the second day between 6 p.m. and midnight and the larva being practically of the same density as of the river water, either floats or remains in midwater. It is 3 mm. long, transparent and unpigmented. The mouth, anal opening and paired fins are absent. The oil globule in the yolk is close to the head region, as a result of which the larva floats almost vertically with the head-end up. The larva lived under laboratory conditions for six days, and the stages could be checked with yolked larvæ and post-larvæ regularly collected from the river along with the yolked larvæ of *hilsa* (*Hilsa ilisha*). The yolk is completely absorbed when the larva is about 9 mm. in length and the post-larval stage is completed when it reaches about 60 mm. To begin with the post-larva feeds on copepods and other minute crustaceans, but as it grows, it takes to small shrimps.

Delasman² has collected and described from the Indonesian waters three kinds of eggs and their larvæ which he concludes as belonging to *Setipinna melanochir*, *S. breviceps* and *S. taty*. The size of the egg and the nature and disposition of the oil globule in the egg and larva of *S. phasa* are comparatively similar to those of *S. melanochir*, though of the above three species only the last two are recorded from the Indian waters.

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* Published with the kind permission of the Chief Research Officer, Central Inland Fisheries.

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ON TWO NEW RUST FUNGI

In November 1949, a rust was observed infecting the leaves of *Themeda triandra* Forsk., in and around Burliar (Nilgiris). Uredia and telia were present. They are described below.

Uredia minute, 0.3-0.5 mm. long, hypophyllous, subepidermal, erumpent, bright yellow; urediospores round or oval, orange yellow 21×19 μ (16-26×15-24), echinulate, pedicellate, pedicel hyaline, with 6-8 germ pores.

Telia rare, mixed with uredia, hypophyllous, black, subepidermal, erumpent; teliospores round, elliptic or polygonal, thick walled, wall up to 6 μ thick, smooth, kaiser brown, 28×25 μ

(21-35 \times 19-33), with one apical germ pore, pedicellate, pedicel up to 32 μ long, persistent, hyaline.

Soris uredosporiferis minutis, 0.3-0.5 mm. longis, hypophyllis, subepidermalibus, erumpentibus, flavidis; uredosporis globosis, vel ovatis, aurantio-flavidis, 21 \times 19 μ (16-26 \times 15-24), echinulatis, pedicellatis, pedicello hyalino, poris germinationis 6-8.

Soris teleutosporiferis raris, urediis immixtis, hypophyllis, atris, subepidermalibus, erumpentibus; teleutosporis globosis, ellipsoides vel polygonis, episporio incrassato, usque 6 μ crasso, levis, unicellulatis, kaiser brunneis, 28 \times 25 μ (21-35 \times 19-33); pedicellatis, pedicello hyalino, persistente, usque 32 μ longo.

On living leaves of *Thermeda triandra* Forsk. (Graminæ), Burliar (Nilgiris), K. V. Srinivasan and T. S. Ramakrishnan.

There are 6-8 germ pores in each urediospore distributed all over; some of these appear to be papillate. The teliospore often has a hyaline papilla opposite the stalk. A single germ pore can be readily distinguished located invariably opposite the pedicel.

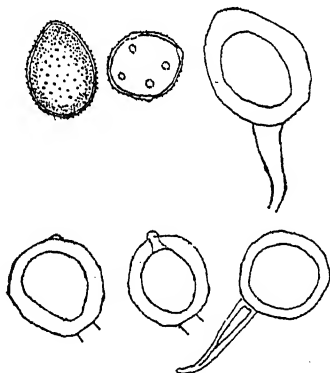


FIG. 1. Urediospores and teliospores of *Uromyces triandra*. ($\times 450$).

Six rusts have been recorded on this host genus namely *Puccinia burmanica* Syd. & Butl., *P. anthistiriae* Barcl. (Butler and Bisby, 1931), *P. versicolor* Diet. & Holw. (Doidge 1926), *Uredo themedicola* Cummin., *U. themedæ* Diet. (Cummins, 1941), and *U. anthistiriae-tremulæ* Petch. (Saccardo, 1925). The rust under study is an *Uromyces* and it is different from those recorded on *Themeda* or allied hosts. Therefore it is named *Uromyces triandrae*.

Uromyces orthosiphonis Ramakrishnan and Srinivasan sp. nov.

A rust was observed on *Orthosiphon glabratus* Benth., in Coimbatore in November 1949.

Numerous uredia were found and in some of these, teliospores had developed. They are described hereunder.

Uredia amphigenous, mostly epiphyllous, subepidermal, erumpent, pulverulent, dark brown; urediospores round or oval, brown, echinulate, with two indistinct germ pores; 22 \times 19 μ (18-27 \times 12-21), pedicellate.

Teliospores mixed with urediospores, chestnut brown, globose, warty, wall up to 4.5 μ thick, 23 \times 22 μ (19-26 \times 21-24), pedicellate, with a hyaline persistent stalk, up to 33 μ long.

Soris uredosporiferis amphigenis, plerumque epiphyllis, subepidermalibus, erumpentibus, pulverulentis, fusco brunneis; uredosporis globosis vel ovatis, brunnels, echinulatis, poris germinationis duobus præditis, obscuris, 22 \times 19 μ (18-27 \times 12-21).

Teleutosporis immixtis, castaneo brunneis, globosis, verrucosis, 23 \times 22 μ (19-26 \times 21-24) episporio usque 4-5 μ crasso, pedicello, hyalino, persistente, usque 33 μ longo.

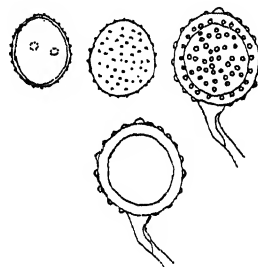


FIG. 2. *Uromyces orthosiphonis* Urediospores and teliospores. ($\times 450$).

On living leaves of *Orthosiphon glabratus* Benth. (Labiatæ) Coimbatore, K. V. Srinivasan and T. S. Ramakrishnan.

The uredia are more numerous on the upper surface. They are either scattered or more often formed in rings round a central uredium. The epidermis flakes off only in late stages. In the initial stages a pore-like opening develops in the centre of the uredium. Hyphoid paraphyses are present at the periphery of the sorus. Sometimes urediospores are seen with a thick hyaline wall. The teliospore develops only in the later stages mixed with the urediospores. Separate telia were not noticed. Each spore has a thick coloured wall studded with numerous warts. An apical papilla is visible in some cases.

Puccinia pallens Syd. (Sydow, H. & P., 1904), and *P. gallerita* Doidge (Doidge, 1926) have been recorded on *Orthosiphon* spp. from Africa.

The rust under study is quite different and is named *Uromyces orthosiphonis*.

T. S. RA MAKISHNAN.
K. V. SRINIVASAN.

Mycology Section,
Agricultural Research Institute,
Coimbatore,
November 29, 1949.

1. Butler, E. J. and Bisby, G. R., *Fungi of India*, 1931, 64 and 75. 2. Cummins, G. B., *Mycologia*, 1941, 33, 151. 3. Doidge, E. M., *Bothalia*, 1926, 2, 126. 4. Saccardo, P. A., *Syll. Fung.*, 1925, 23, 929. 5. Sydow, H. and P., *Monogr. Ured.* 1904, 1, 876.

FLUORESCENT INDICATORS FOR ACID-BASE TITRATIONS—PART II

IN continuation of our previous note¹ the fluorescence changes with change in pH of the remaining coumarin derivatives in our collection are here reported. The coumarins which did not yield prominent changes in the range of pH 3.1 to 10.1 in the previous investigation were re-examined at other ranges to complete the investigation. The results with coumarin² are included for comparison.

S. No.	Indicator	Colour change	pH range
1	7-Methoxy-3-phenyl-coumarin	Deep blue to colourless	10.1-14.0
2	7-Methoxy-4-methyl-coumarin	Nil	0.1-10.1
3	5-Methoxy-4 : 7-di-Methyl coumarin-3-acetic acid	"	"
4	" Ethyl ester	Nil to blue	1.1-8.1
5	5 : 7-Dimethoxy-4-methyl-coumarin-3-acetic acid	Blue to deep blue	"
6	" Ethyl ester	"	0.1-3.1
7	5-Methoxy-4 : 7-di-methyl-coumarin	Very pale yellow to pale blue	0.5-3.1
8	3-Acetyl-7-methoxy-8-methyl coumarin	Blue to colourless	10.1-14.0
9	5 : 7-Dimethoxy-4-methyl coumarin	Pale blue to blue	<0.1-1.1
10	Dicoumarin	Greenish yellow to blue	0.1-3.1
11	Umbelliferone-8-aldehyde	Pale blue to blue	4.1-6.1
12	5-Methyl 3-carb-ethoxy umbelliferone	Deep violet to deep blue	<0.1-0.1
13	4 : 8-Dimethyl umbelliferone	Yellow to blue	0.1-3.1
14	Coumarin	Weak green to bright green	9.8-12.0

The data show that while in general the umbelliferones show a marked fluorescence colour

change in the neighbourhood of the neutral point, the coumarins, without a hydroxyl, require strongly acid or alkaline ranges. Two exceptions have been noted among umbelliferone derivatives.

Grateful thanks are due to Prof. T. R. Seshadri for placing at our disposal the large number of synthetic samples.

Andhra University,
Waltair,
December 17, 1949.

K. NEELAKANTAM.
G. VISWANATH.

1. Neelakantam and Viswanath, *Curr. Sci.*, p. 15 of this issue. 2. Radley and Grant, *Fluorescence Analysis in Ultra-violet Light*, 1939, 3rd edition.

TELIA OF THE RUST ON CULTIVATED FIGS

Cerotelium Fici (Cast.) Arth. is widely distributed in the tropical and subtropical regions where figs are cultivated. The rust also occurs on many wild species of *Ficus*. Arthur¹ placed the rust under *Physopella* as *P. Fici* (Cast.) Arth., but latterly, *Physopella* has been merged partly with *Phakopsora* and partly with *Cerotelium*.

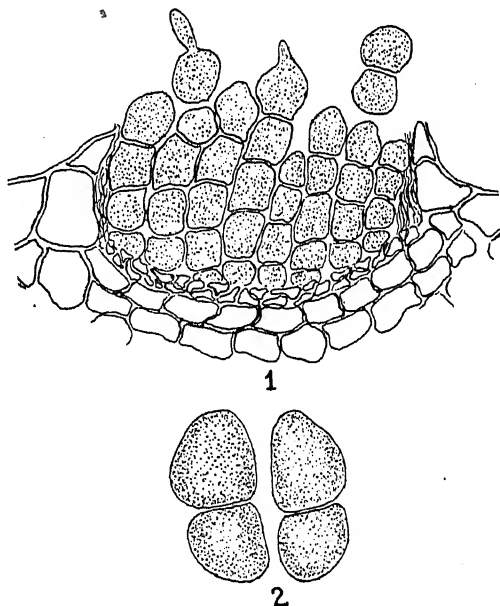


FIG. 1. Section through telium $\times 450$.

FIG. 2. Teliospores $\times 800$.

The rust on all the species of *Ficus* including the cultivated figs occurs only in the uredial stage, except in one collection of telial stage

made by Butler² near Pusa, India, on the wild fig, *Ficus glomerata*. All references to the telial stage of *Cerotelium Fici* are based upon Butler's description.

Telia of *C. Fici* on cultivated figs were collected on plants growing in Benares Hindu University Campus, during defoliation in November. The telia are indistinguishable from the ureidia, except for the less powdery appearance, visible under magnification.

Telia are mostly hypophyllous, cinnamon-yellow, waxy, subepidermal and erumpent. Teliospores are hyaline, one-celled developed in catenulations. Mature spores are oblong-ellipsoid to ovate and germinate immediately. Measurements of teliospores from the telia on cultivated figs are $14-21 \times 11-13 \mu$, and these are almost identical with those given by Butler ($15-22 \times 10-13 \mu$) for those on *Ficus glomerata*.

Though the rust incites heavy defoliation of the shoots during the fruiting stage, the damage is rather slight as replacement follows vigorously.

M. J. THIRUMALACHAR.

D. V. SUBBA RAO.

V. RAVINDRANATH.

Dept. of Plant Pathology & Mycology,
Benares Hindu University,
December 5, 1949.

1. Arthur, J. C., *Manual of Rusts in United States and Canada*, Lafayette, Indiana, 1934, pp. 438. 2. Butler, E. J., *Ann. Mycol.*, 1914, **12**, 76-82.

THE INFLUENCE OF THE INTAKE OF COCONUT OIL ON CALCIUM BALANCE

THE relationship between calcium utilization and intake of coconut oil is important because it is almost the only oil consumed by certain classes in South India. If, as the results of Basu and Nath^{1,3} would show, intake of coconut oil is associated with a negative calcium balance, diseases due to calcium deficiency should have been widely prevalent. Since this has not been reported so far, it was felt necessary to re-examine this problem.

Six adult, litter-mate rats were fed on a diet similar to that used by Basu and Nath excepting for the use of casein in the place of fish. The diet analysis showed 9.98 per cent. protein, 7.44 per cent. fat, 0.093 per cent. calcium (Ca) and 0.158 per cent. phosphorus (P). Collection of urine, faeces and diet was made for a period of four days and for comparison, ghee (clarified butter) was used in the place of coconut oil. The results of the experiment are presented in Table I.

TABLE I

Nitrogen, calcium and phosphorus balance in rats fed on coconut oil and ghee

Fat	In diet mg.	In urine mg.	In faeces mg.	Balance mg.
Nitrogen				
Coconut oil	790.0	279.0	177.7	333.3 ± 39.99
Ghee	834.7	258.9	202.9	372.9 ± 18.30
Phosphorus				
Coconut oil	78.2	29.2	19.0	30.0 ± 5.28
Ghee	82.6	29.0	20.6	33.0 ± 4.05
Calcium				
Coconut oil	46.10	2.22	15.02	28.86 ± 4.35
Ghee	48.70	2.16	12.52	34.02 ± 2.11

A positive calcium balance was noticed in all cases and there was no appreciable difference between coconut oil and ghee as far as the assimilation of nitrogen, calcium and phosphorus are concerned.

Grateful thanks are due to the Parlakimedi Trust of the Indian Research Fund Association for the award of a scholarship.

V. SADASIVAN.

Nutrition Research Laboratories,
Indian Research Fund Association,
Coonoor, India,
October 16, 1949.

1 Basu, K. P., and Nath, H. P., *Indian Journal Med. Research*, 1946, **34**, 13. 2. —, *Ibid.*, 1946, **34**, 19. 3. —, *Ibid.*, **34**, 27.

REVIEWS

Fundamental Algebra with Practical Applications. By Robert L. Erickson. (McGraw-Hill Book Company, Inc.), 1949. Pp. xi+317. Price \$ 2.80.

The author describes the book as "a basic mathematics course which reviews and integrates the fundamentals of the arithmetic of numbers and the rigorous logic of the arithmetic of letters, namely algebra". The description will be misleading to a reader who has any highbrow notions of fundamentals and rigorous logic. The book is intended for "vocational, technical, pre-engineering, pre-medical, pre-commerce, pre-science, and pre-statistical courses" and as such its scope is very elementary. Of late many such books have been coming out from American authors and it is a clear sign of the healthy and vigorous anti-illiteracy drive that exists in the new world. These are vast areas of knowledge today that are inaccessible except through the language of mathematics and every effort that is made to save the citizen from mathematical illiteracy deserves to be praised.

It is very difficult to be both precise and lucid in a mathematical exposition. The teacher who is aware of the measure of understanding of his pupils is conscious of the difficulty. That does not however mean that precision must always be sacrificed for lucidity. In the book under review one comes across statements now and then which hurt one's mathematical conscience. A few may be stated: (i) "Even simple tasks, such as measuring a cup of sugar, sweeping the floor, running for a touchdown, washing the dishes, etc., involve equations" (p. 129). (ii) "A second-degree equation is defined as the sum of the exponents of the variables of any monomial term that is equal to 2" (p. 160). (iii) "A complex number is a number that involves a real and a pure imaginary number" (p. 220). It may be mentioned that about twenty-two pages of the book are devoted to easy quadratic equations and about sixty pages to the primary operations of arithmetic. In addition to the treatment of elementary problems in school algebra the book contains useful information about several topics such as determinants, logarithms, progressions, the slide rule and elementary trigonometry. The printing and get-up of the book are excellent, and the selection of problems is made from every-day life so as to create an interest in mathematics.

V. V. N.

Ions, Electrons and Ionizing Radiations. By J. A. Crowther, (Edward Arnold & Co., Ltd. London), 1949. Pp. 322. Price 21 sh.

The volume under review is the eighth edition of a book with the same title which was first published in 1919. In the preface to the first edition, the author described it as a text-book from which students who have been grounded in the more elementary portions of physics might obtain a systematic knowledge of its later developments. Because of its extreme popularity among students of physics, the book has been revised and reprinted many times during the past thirty years. As a result of the unparalleled outburst of discovery during this period, the contents of the book have undergone many changes. But its title as well as its purpose remains unaltered.

Here it is proposed to review only the notable changes that have been introduced in the book since the last revision which appeared in 1938. During the past eleven years a very considerable extension of our knowledge in the field of nuclear physics and cosmic rays has taken place. The large-scale release of atomic energy has also become a reality. In this new edition, therefore, the chapters on cosmic radiation and on the physics of the nucleus have been almost entirely re-written, and a new chapter dealing with nuclear energy added. Many sections of the other chapters have been suitably modified so as to make them up to date.

In the book under review, the author has given a brief but comprehensive outline of the development of atomic physics starting with the discovery of the electron and ending with the release of atomic energy. Wherever possible, the mathematical treatment of the subject has been very much simplified. It will continue to serve as a useful text-book for the undergraduate course in physics. R. S. K.

Industrial High Frequency Electric Power. By E. May. (Chapman & Hall, Ltd.), 1949. Pp. xii + 355. 32 sh.

Though a number of publications have been published in different scientific and technical journals on the generation and the application of high frequency power, comprehensive works covering a wide range are few. This publication will therefore prove very helpful to industrial engineers who may have occasion to use high frequency power.

Graphical representation has been used throughout the text to convey the conclusions reached by analytic methods regarding the behaviour of different parts in an electrical circuit at very high frequencies.

Basic principles of LCR systems and resonance conditions have been discussed and the principles of construction and operation of the iron and air-cored H.F. transformers dealt with.

The design and operation of all the different types of industrial high frequency generators—such as arc and spark oscillators, wound rotor and inductor alternator for frequency ranges from 2 to 80 kilocycles and for power ratings from 2 to 500 K.W.—have been fully discussed.

For frequencies above 50 kilo-cycles dynamo electric machinery become increasingly difficult to handle. The characteristics and use of thermionic valve oscillators for such high frequencies have been fully treated. A chapter on the design and performance of classes B and C amplifiers is also included.

The characteristics of different shapes of the charge, *viz.*,—solid or hollow cylinder, flat strips or plate and plane surfaces, are fully dealt with. Different methods of heat treatment, such as continuous progressive hardening and through hardening, are also discussed.

The book concludes with a discussion of the wide field of applications of the H.F. power to industry and the various operating problems associated with it. The book is copiously illustrated. A large number of typical problems have been worked out to illustrate the different principles discussed. A bibliography of technical literature on the subject is given at the end of the book for easy reference.

C. S. G.

The Terpenes, Vol. II. The Dicyclic Terpenes and Their Derivatives. By J. L. Simonsen. Second Edition: revised and reset by J. L. Simonsen and L. N. Owen. (Cambridge University Press), 1949. Pp. 619. 35 sh. net.

In view of the great progress made in the study of dicyclic terpenes and the sesquiterpenes since the publication of the first edition of this classical work in 1932, the authors have devoted this volume entirely to the chemistry of dicyclic terpenes, reserving the third volume for the sesquiterpenes and diterpenes. Readers familiar with the first edition will find no departure in the general plan and scope of the subject-matter, as the developments in this field during the intervening period have been more in res-

pect of detail than of principle, and these have been incorporated in appropriate places without greatly altering the main body of the text. Nevertheless, considerable new material has been included.

Broadly speaking, the advances in our knowledge of dicyclic terpenes during the last two decades relate to: (i) Total synthesis of many members of this group and study of their degradation products; (ii) Stereochemical and configurational relationships of many alcohols and ketones of this series and (iii) Extension of our knowledge of Nametkin's and Wagner Meerwein's isomerisations. These topics are described clearly and adequately and in a manner characteristic of Professor Simonsen. Among the notable contributions may be mentioned the total synthesis of pinene the most important terpene that occurs in nature, the interesting synthesis of borneol and epiborneol, further clarification of the chemistry of the fenchenes and investigations of the stereochemical relationship of isomeric pino-campheols and pinocarveols. A new member having somewhat unusual tricyclic structure, 1- Δ^3 -carene-5:6-epoxide has been discovered by Penfold and Simonsen in the essential oil of the leaves of *Zieria Smithii*.

The text has been carefully revised and minor errors of the previous edition rectified. In spite of this, mistakes like ethyl *glutarate* for ethyl glutaconate (page 68, line 11), cadmium methyl chloride for cadmium methyl bromide (page 148, line 18) and the structural formula XV (page 141) are noticed. It may be rather misleading to state "*dl*-trans-pinonic acid, m.p. 103-5°" (page 148, line 20) in view of the work of Delepine on the interconversion of *cis* and *trans* forms which is mentioned on page 147. These are however, minor points which may be overlooked in a classical work of this kind.

There has been no mention of the unusual hydrocarbon, orthodene, described by Fujita; the reviewer feels that its inclusion in the text might serve to stimulate further work on the conclusions arrived at by Fujita.

The present edition will no doubt be as well received as the previous one.

P. L. N. RAO.

Psychical Physics. By S. W. Tromp, (Elsevier Publishing Company Inc. New York), 1949. Pp. xv + 534. Price 8-00 \$.

As early as 15th century, the prospectors for minerals in the German mining districts used the dowsing or divining rods. In modern times the professional dowser is a 'water finder',

and there has been a great many investigations of his claim to locate underground water, by the use of a forked hazel twig. A widespread faith exists based on frequent success, in the dowser's power. Prof. Sir W. F. Barrett who investigated the phenomena was satisfied that there was no voluntary deception on the part of the dowser, and ascribed the phenomenon to "motor automatism"—a reflex action excited by some stimulus upon the mind of the dowser which may be either a subconscious suggestion or an actual impression. The dowser's power lies beneath the level of conscious perception and the forked twig or the divining rod acts as an index of some mental disturbance within him which otherwise he could not interpret.

The author in this publication tries to give an explanation of the various aspects of divining by an analysis of the influence of external electromagnetic fields on psychic and physiological phenomena in living organisms. The author, a geologist, has met many dowsers in his work and was always sceptical of their powers since the results he had seen were never very convincing. Around 1940, however, important data were collected which seemed to indicate that divining phenomena were as real as electricity and other physical phenomena. During recent years, tests were arranged in the physical and physiological laboratories of Leiden University (Holland) and in the Laboratory of Technical Physics at Delft (Holland). Experiments with artificial magnetic fields and string galvanometers indicated that divining phenomena can be explained by normal physical and physiological laws and that a careful analysis of these phenomena might prove to be of great value to future medical science.

The book is divided into three chapters, and commences with an analysis of the electromagnetic fields in and around living organisms. In this chapter the author discusses bioelectricity, viz., the electrical fields of man, animal and plant as well as the geophysical, climatological and meteorological fields. The next chapter adduces further evidence of the influence of external electro-magnetic fields on the living organism. Herein the author discusses the influence of external electrostatic fields in general, the influence of atmospheric ionic currents, of magnetic fields and of electromagnetic radiations. A summary is given of the different geological and geophysical factors that influence living organisms.

In the third chapter, divining and kindred phenomena have been analysed scientifically and the author's experiments described in de-

tail. This last chapter is divided into five parts. In part I the author discusses rhabdomancy or the phenomenon of water divining or dowsing; part II describes *radiesthesia* or *pallomanancy*; part III, magnetizer phenomena (hypnotism); part IV, sensitivity for direction of animals; and part V, *psychical physics*. There is a strong objection to the use of the word 'psychical physics' by the vitalists, who are convinced that psychical phenomena are ruled by a group of laws fundamentally different from the physical laws. But the author holds that such a distinction is not based on facts; psychic phenomena can be approached by using physical and physico-chemical methods. For those readers who are not sufficiently acquainted with electromagnetic terminology, a summary of the basic physical conception and units used is included in the appendix.

In this treatise the author has endeavoured to demonstrate that an enormous number of fundamentally unknown phenomena exists in the living world and he emphasises the fact that our sphere of interest should lie in the direction of explaining these phenomena by co-ordinative work of scientists who would combine intelligence with highly critical mind and unprejudiced conception.

An extensive bibliography is included for those interested in further research in this line. The reader will find the book highly instructive and interesting.

N. N. DE.

Studies on Local Anaesthetics: Xylocaine--A New Synthetic Drug. By Nils Löfgren. Stockholm, 1948.

The book concerns itself mainly with an investigation of local anaesthetics from a structural and physico-chemical point of view, their mechanism of action, and the introduction by the author of a new and useful local anaesthetic—xylocaine.

Chapter I is devoted to a survey of the old and the new local anaesthetics used in medical practice. General views on the chemical constitution of local anaesthetics are given in the following chapter which deals mainly with amino groups and aromatic structures. Earlier investigations on aminoacyl—and dialkylamino acyl anilides are described in Chapter IV. The author has synthesised a fairly large number of such compounds, and describes, in a special chapter, the properties of xylocaine, its physico-chemical characteristics, anaesthetic activity, toxicology, etc. The molar refractions and absorption spectra in the ultraviolet of some representative molecules are described in detail and compared

with those of local anaesthetics. Determination of thermodynamic ionisation constant is of great interest not only from a structural but also from a physiological point of view; and it is interesting to note that by means of determination of ionisation constant it has been possible to analyse the influence of pH on the activity of local anaesthetics. In the last chapter the local anaesthetic action is discussed as a disturbing effect on the lipo-protein film at the surface of plasma membrane and different fine-mechanism of action are proposed for indifferent narcotics and local anaesthetics.

The text contains ample references to original papers. The subject-matter will be of great use to workers interested in this field.

N. N. DE.

1. Transaction of the Fifth Tuberculosis Workers' Conference held in Madras, January 1948. (Pp. xxii + 173).

2. Proceedings of the Sixth Tuberculosis Workers' Conference held in Calcutta, December 1948. (Pp. xiv + 226).

(Published under the auspices of the Tuberculosis Association of India.)

The proceedings of the 5th and 6th Conferences on tuberculosis reviewed here serve to emphasise that next to malaria, tuberculosis is the biggest medical problem in India, and that the immediate implementation of anti-tubercular measures to combat the almost epidemic spread of the disease cannot be delayed any longer. 500,000 deaths and nearly 2,500,000 active infections occurring annually indicate the seriousness of the situation.

Gross malnutrition, scarcity of food, overcrowding and insanitation, the sudden influx of evacuees, the concentration of large number of men, women and children in the evacuee camps, and the accompanying privations have all contributed to the spread of the disease.

Early diagnosis by mass miniature radiographic survey, B.C.G. vaccination of the susceptible age groups, segregation of affected patients and adequate surgical and medical treatment in sanatoriums are mentioned as indispensable to an effective programme of tuberculosis control.

Government of India with the assistance of W.H.O. have started preparation of B.C.G. vaccine and have organised a campaign of mass immunisation. Evaluation of results will be awaited with interest.

Streptomycin has a definite place in the chemotherapy of tuberculosis but because of its slight toxic effect and the development of drug resistant organisms, it has to be employed with discrimination.

The interrelationship of physical, emotional and social factors has recently begun to receive recognition in the practice of medicine. The important role of the "social worker" in tuberculosis is recognised.

Organised tuberculin survey of the population, research in the field of immunology, immunochemistry and allied problems, and an all out co-ordinated effort by the Government, local bodies and social workers to improve the environment are recommended as necessary measures for the campaign against tuberculosis.

M. SIRSI.

ERRATA

Table II in the note on the Chemical Examination of the seeds of *Luffa Graveolens* Roxb. and *Luffa echinata* Roxb. (p. 451, 18. Dec. 1949, *Curr. Sci.*) must read as follows:—

TABLE II

Constant	A			B		
	Mixed acids	Solid acids	Liquid acids	Mixed acids	Solid acids	Liquid acids
Refractive index at 31°	.. 1.4695	..	1.4780	1.4775	..	1.4710
Iodine value	.. 107.60	2.065	135.40	82.12	0	107.90
Acid number	.. 187.90	215.9	187.10	187.2	200.2	168.10
Mean molecular weight	.. 298.0	259.5	299.30	299.0	279.7	333.10
Percentage, saturated acids	..	20.78	..	..	25.0	..
Percentage, unsaturated acids	..	..	79.22	..	..	75.0
Titre value	24.25° C.	47.25° C	..	23.75° C.	48.0° C.	..

Chemistry Lab.,
St. John's College,
Agra, and
K. C. PANDYA.
JAGAT NARAYAN TAYAL.

RAM GHULAM SINGH NIGAM.
Agra Medical College,
Agra,
January 5, 1950.

SCIENCE NOTES AND NEWS

Indian Academy of Sciences

Officers for 1949-52: President:—Sir C. V. Raman; *Vice-Presidents:*—Prof. S. Bhagavantam (Osmania University); Dr. V. R. Khanolkar (Tata Memorial Hospital); Dr. Mafa Prasad (Royal Institute of Science, Bombay); Prof. T. R. Seshadri (Delhi University).

Newly elected Fellows of the Academy:—Prof. G. B. Dube (Patna); Dr. M. V. Radhakrishnan (Bombay); Dr. G. N. Ramachandran (Bangalore); Dr. A. Srinivasan (Bombay).

Indian Science Congress: 1951

Dr. H. J. Bhabha, F.R.S., Director of the Tata Institute of Fundamental Research, has been elected President of the Indian Science Congress, 1951, proposed to be held in Calcutta. The Sectional Presidents are: *Mathematics:* Dr. C. Racine (Madras); *Statistics:* Mr. A. R. Sinha (Calcutta); *Physics:* Dr. C. S. Venkateswaran (Trivandrum); *Chemistry:* Prof. R. C. Shah (Bombay); *Geology:* Dr. J. B. Auden (Calcutta); *Botany:* Dr. B. B. Mundkur (Delhi); *Zoology:* Dr. N. C. Chatterjee (Dehra Dun); *Anthropology:* Mr. S. S. Sircar (Calcutta); *Medical and Veterinary Sciences:* Dr. G. Sankaran (Calcutta); *Agricultural Sciences:* Dr. J. K. Basu (Calcutta); *Engineering:* Prof. M. S. Thacker (Bangalore).

National Institute of Sciences of India

Ordinary and Honorary Fellows of the Institute elected in January 1950: *Ordinary Fellows:* Dr. D. P. Antia (New Delhi); Dr. F. C. Auluck (Delhi); Dr. P. L. Bhatnagar (Delhi); Dr. K. Biswas (Sibpur, Howrah); Dr. J. P. Bose (Calcutta); Dr. R. N. Chaudhuri (Calcutta); Dr. V. M. Ghatage (Bangalore); Dr. H. Gupta (Hoshiarpur); Dr. T. J. Job (Manirampur, Barrackpore); Prof. R. S. Krishnan (Bangalore); Prof. M. C. Nath (Nagpur); Dr. H. N. Ray (Mukteswar-Kumaun); Dr. M. R. Sahni (Calcutta); Dr. A. Srinivasan (Bombay); Dr. R. S. Vasudeva (New Delhi).

Honorary Fellows: Prof. P. Debye (U.S.A.); Prof. M. von Laue (Germany); Prof. M. Siegbahn (Sweden); Prof. E. Schrodinger (Dublin, Eire).

Officers and Members of the Council for 1950:—*President:* Prof. S. N. Bose (Calcutta); *Vice-Presidents:* Prof. A. C. Banerji (Allahabad); Dr. K. S. Krishnan (Delhi); *Treasurer:*

Dr. C. G. Pandit (Delhi); *Foreign Secretary:* Dr. J. N. Mukherjee (Delhi); *Secretaries:* Prof. D. S. Kothari (Delhi); Dr. H. S. Pruthi (Delhi); *Editor of Publications:* Dr. S. L. Hora.

Members of Council: Dr. S. P. Agarkar (Poona); Prof. K. N. Bahl (Lucknow); Dr. S. K. Banerjee (Delhi); Mr. S. Basu (Poona); Prof. S. R. Bose (Calcutta); Dr. B. C. Guha (Calcutta); Prof. A. C. Joshi (Hoshiarpur); Dr. S. Krishna (Dehra Dun); Prof. R. C. Majumdar (Delhi); Dr. H. R. Mehra (Allahabad); Mr. G. R. Paranjpe (Poona); Prof. P. Parija (Benares); Dr. L. A. Ramdas (Poona); Mr. J. M. Sen (Calcutta); Prof. N. R. Sen (Calcutta); Dr. P. V. Sukhatme (Delhi); Dr. A. C. Ukil (Calcutta).

The Indian Botanical Society

Officers and Council for 1950:—*President:* Dr. B. P. Pal (New Delhi); *Vice-Presidents:* Dr. G. P. Majumdar (Calcutta); Dr. T. S. Mahabale (Bombay); *Hon. Secretary:* Dr. R. Misra (Saugor); *Councillors:*—Dr. P. Maheshwari (Delhi); Dr. A. C. Joshi (Hoshiarpur); Dr. R. L. Nirula (Nagpur); Dr. L. Narayan Rao (Bangalore); Dr. Shri Ranjan (Allahabad); Sri. M. B. Raizada (Dehra Dun); Dr. M. O. P. Iyengar (Madras); Dr. P. N. Mehra (Amritsar); Dr. I. Banerji (Calcutta); Dr. R. K. Saksena (Allahabad).

Indian Ecological Society:

Officers and Council for 1950:—*President:* Dr. F. R. Bharucha; *Vice-Presidents:* Dr. R. D. Misra, Dr. J. K. Basu; *Hon. General Secretary and Hon. Treasurer:* Dr. B. S. Navalkar; *Hon. Joint Secretary:* Dr. T. J. Job; *Members of the Executive Council:* Dr. J. V. Bhat, Dr. N. L. Rao, Mr. P. J. Dubash, Mrs. E. Gonzlaves, Dr. T. S. Mahabale.

Indian Phytopathological Society:

Officers and Council for 1950:—*President:* Dr. B. B. Mundkur; *Vice-President:* Dr. K. C. Mehta; *Secretary-Treasurer (1950-52):* Dr. R. Prasada; *Councillors:* North Zone:—Dr. B. Chona; Mid-Eastern Zone:—Dr. P. R. Mehta; Eastern Zone:—Dr. S. R. Bose; Central Zone:—Dr. S. Vaheeduddin; Western Zone:—Dr. M. K. Patel; Southern Zone:—Mr. D. Marudurajan.

Pan-Indian Ocean Science Congress

A Pan-Indian Ocean Science Congress is to be held in India immediately after the 1951 session of the Indian Science Congress on the lines of the Pan-Pacific Science Congress sponsored by America a few years back. The report says that the suggestion for holding the Congress was made by Prof. A. D. Ross, Chairman of the Australian National Research Council, who pointed out that such a Congress would be able to discuss many scientific and technological problems peculiar to this zone, besides contributing to closer international understanding.

The Executive Committee of the Indian Science Congress, after having approved the idea, approached the Department of Scientific and Industrial Research for the opinion of the Government of India, and it is now definite that the venue of the first session of the PIOSC will be India, its organization being entrusted to the Indian Science Congress.

International Scientific Radio Union

Union Radio Scientifique Internationale (International Scientific Radio Union) will hold its ninth General Assembly in Zurich from 11th to 23rd September, 1950. As a rule communications only from members of National Committees are accepted for the proceedings of the Assembly. Pending the appointment of National Committees in the countries of South Asia, it has been made possible for scientists of this region to submit individual communications to the forthcoming General Assembly. The Secretary-General of the above U.R.S.I. has notified that papers on radio science for being included in the proceedings from scientists of this region should reach him at 42, Rue des Minimes, Bruxelles (Belgium) before 1 July, 1950. Proceedings of the Assembly will be published both in English and French and the text of the communication should be both in English and French, and should be sent in three copies. Each communication should be accompanied by 2 copies of an abstract.

International Union for the History of Science

The fifth General Assembly of the International Union for the History of Science will hold its session at Amsterdam from 14th to 21st August, 1950. It has been decided to hold a symposium on "Scientific Relations between the East and the West from the historical point of view". Scientists and historians of science who

are interested in this subject and have any contributions to send may kindly communicate to the Principal Scientific Officer of this Office. The communication may be prepared in English but a summary in French will be useful. The paper should not take more than 15 minutes to read. The attention of scientists is drawn especially to the above Symposium as their contributions would demonstrate the prominent role of the East in the development of sciences.

Indonesian Organisation for Scientific Research

Copies of the constitution of the Organisation for Scientific Research in Indonesia (in Dutch and English) are available for distribution. They have also sent copies of the Central Catalogue of their Scientific Libraries which contain in addition information on the Indonesian scientific publications. Copies may be sent to scientific institutions on hearing from them.

Mr. S. L. Tandon

Mr. S. L. Tandon, M.Sc., Assoc. I.A.R.I., Lecturer in Botany, University of Delhi, has been appointed as Research Assistant in Botany, at the State College of Washington, Pullman, Washington, U.S.A.

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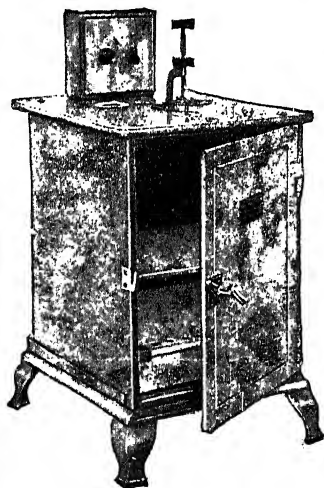
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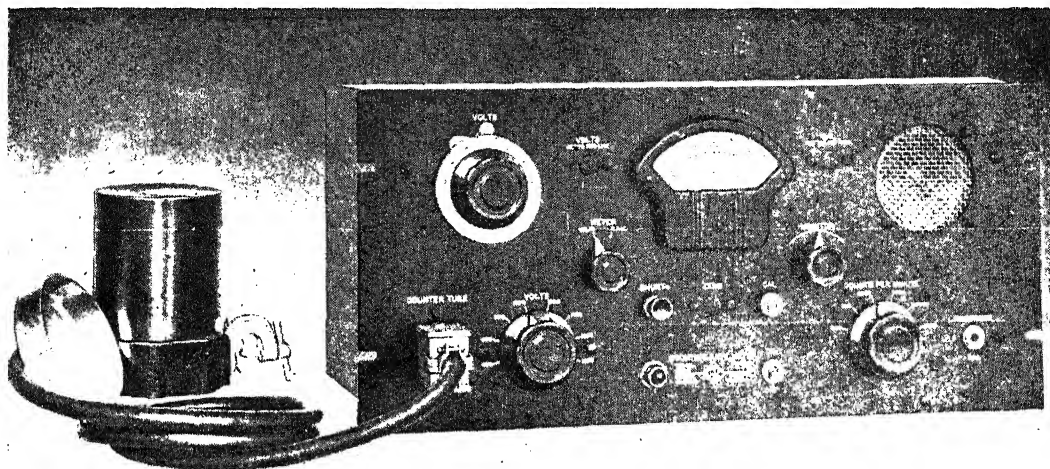
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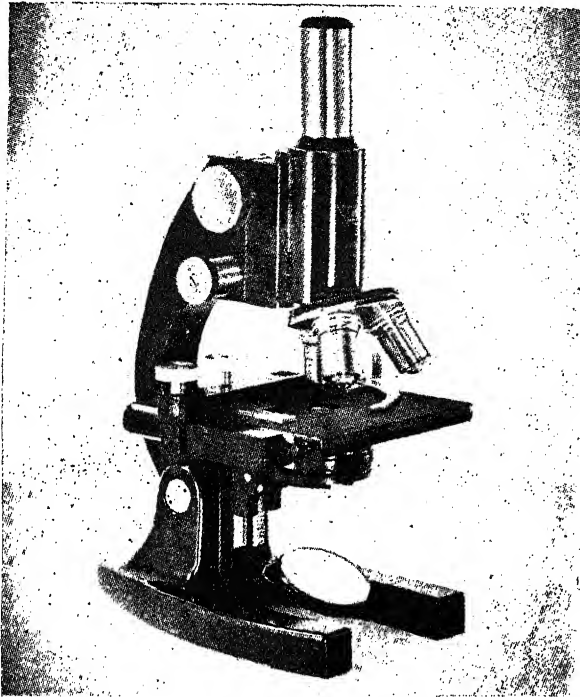
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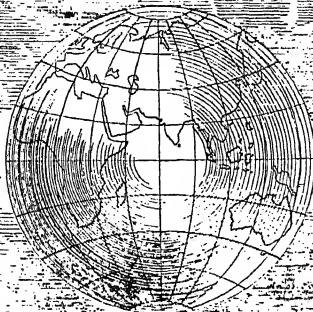
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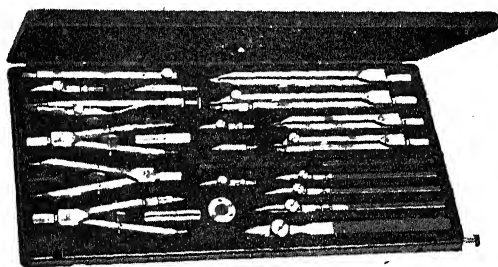
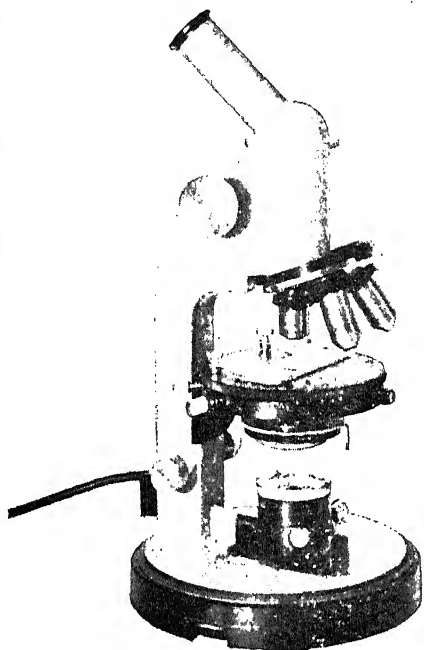
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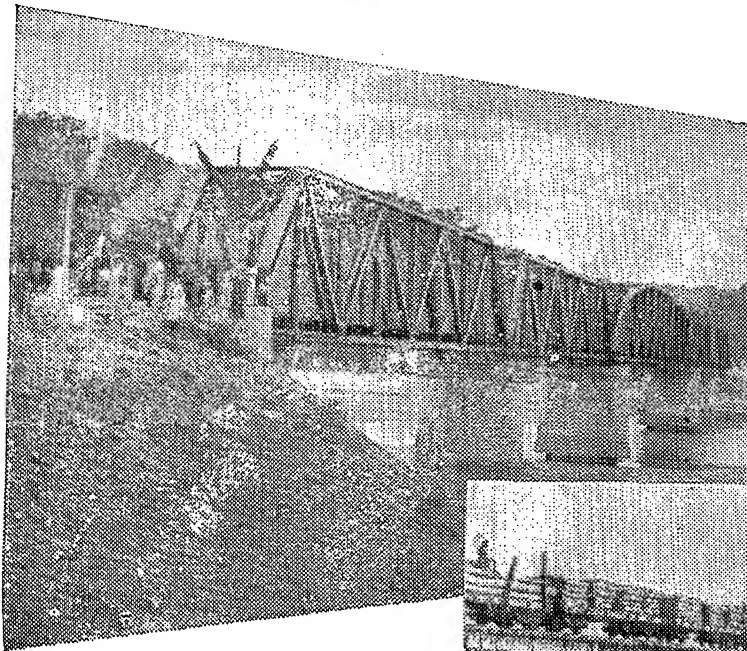
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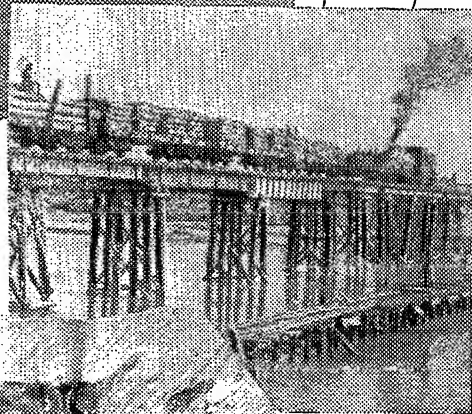
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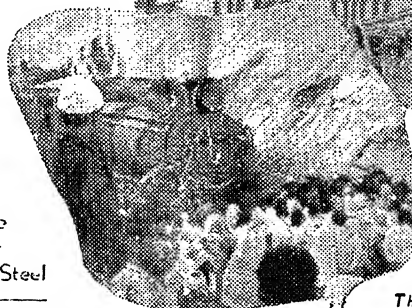
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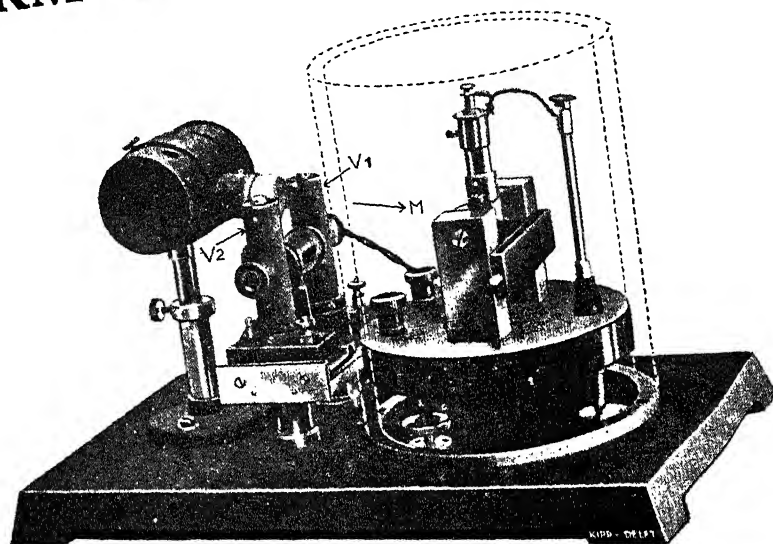
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THE NATIONAL PHYSICAL LABORATORY, NEW DELHI

Its Genesis, Organisation, Scope and Function*

BY

SIR S. S. BHATNAGAR, F.R.S.

IN 1941, I made known to the Government that the combined physical and chemical laboratory of which I was then Director was wholly inadequate for meeting the needs of scientific developments in the new India and I placed my recommendations before the then Government for an early establishment of a National Chemical and a National Physical Laboratory. It took two years for that Government to accept the proposal; and when accepted the funds allotted for these laboratories were to be given spread over four or five years after

the War. Those who know what skill and patience is needed to get any grant from the Finance Department will well realise the difficulties through which we had to pass. Sir Jeremy Raisman was then Member-in-charge of Finance and I told him one day quite seriously that India will accuse him of doing everything possible to lose the War in the most economical manner if he did not help the movement for encouragement to Science in the country! While the attitude of the present National Government is certainly more helpful, it cannot be said that sufficiently large sums of money have been given by the Government to develop Indian Science to the stature to which she should rise if India is to play her legitimate

* From a speech delivered on 21-1-1950 on the occasion of the Opening Ceremony of the National Physical Laboratory.

role as an important free country in the world. The rumour that Scientific Research has suffered no cuts in the budget is incorrect. We had to suffer equally with the others.

It was only in 1945 that some funds were made available and a planning committee was appointed which prepared the initial plans. In preparing this plan, I and some members of the Planning Committee had the advantage of the experience which we gained when we visited U.K. and U.S.A. in 1944-45 as guests of the U.K. and the U.S.A. Governments respectively. We made a special study of the new designs and equipments in the U.S.A. in such laboratories, as the Bell Telephone Company's Laboratory, the R.C.A. Laboratory, the North-Western University Laboratories and the Carnegie Institute in Pittsburg, the M.I.T., the Caltech, the Mellon Research Institute and the four famous regional laboratories of the U.S.A. The plans were placed before Messrs. Master, Sathe & Bhuta, famous Bombay architects, who have also designed our National Chemical Laboratory which was recently opened at Poona by the Prime Minister, and these two buildings have enhanced their reputation as architects of skill and integrity in India.

The main features of the building are provision of air conditioning, flexibility which allows a change in the sizes of rooms in steps of six feet units at will, a long basement which serves as a store as well as a tunnel for protected services such as gas, steam, electricity and compressed air. These services lie vertically in every room in the Laboratory without winding themselves round the walls and corridors thus saving lakhs of rupees and providing means of introducing any new service lines which may be necessary without having to dig into the walls and floors of the rooms. We have a temporary workshop which is fairly good, but a splendid workshop is nearing completion and we have selected a Czechoslovakian expert to be in charge of it. We hope to be able to manufacture all kinds of instruments we need ourselves. We shall be glad to help advanced research workers in Universities and Governments by giving them the guidance of our experts and the use of our equipment for anything difficult which they cannot make themselves.

Our enlightened Council of Scientific and Industrial Research was alive to the need of a suitable Director as without such a man the buildings alone might degenerate into a body without a soul. India has distinguished herself in Physics and has provid-

ed a majority of Indian Fellows of the Royal Society and a Nobel Laureate. I was certain that we will not have to go out of the country to get an expert to guide the destinies of this Laboratory. We selected unanimously Dr. K. S. Krishnan, F.R.S., whose fame as a physicist transcends the limits of this country. In Indian physics the most sensational discovery for which Sir C. V. Raman was awarded the Nobel-Prize is the Raman Effect. As we all know our distinguished Director was most intimately associated with this discovery. He is a scholar of eminence and yet his genius does not originate in mental eccentricities; its poise and depth rest on the solid foundation of innate culture and a balance without which co-operative effort in research is an impossibility.

My pride is, that with the help of our Government and the people, I have succeeded in creating a ladder and in placing a sure-footed and tried leader on the first run. The first rung of a ladder is a place of resting for no one. It only holds a man's foot long enough to enable him to put the other somewhat higher and I have faith and confidence in our Director's ability to climb up higher and higher till India's National Physical Laboratory reaches that pinnacle of achievement which distinguishes our Himalayan peaks from the rest of the mountains of the world.

Dr. K. N. Mathur, Assistant Director and Officer-in-charge of Planning, has worked with extraordinary devotion. Every brick in this building claims familiarity with this devoted officer. Dr. Mathur combines in him the exactness of a physicist and the imagination of an artist. The country owes him a deep debt of gratitude for this noble building. We have been old collaborators in the field of magneto-chemistry and I wish to congratulate him personally for the solid contribution he has made to the progress of science in this country.

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- (ix) Analytical Chemistry.

Besides these nine Divisions in the original plan, a tenth Division on Industrial Physics has been added to the Laboratory. The National Physical Laboratory will give that stimulus to the development of industry which in the past appears to have been a prerogative of the subject of Chemistry. In fact Physics is proving so useful to Industry that it seems to have already caught up with Chemistry and if Engineering is to be classed as applied physics, I venture to say that it has already beaten Chemistry.

One aspect of fundamental research work which can hardly be neglected in India is that it requires specialised large-scale laboratories. During recent years, and particularly during the last world war, organisation of scientific work has undergone vast changes. Not only does some of the present type of work require large-scale specialised organisations well outside the scope of university work but also expenditure of large sums of money which could only be justified if diversified, co-ordinated and regulated application and professional continuity of work are guaranteed. This is not usually possible in the universities where teaching and research necessarily go hand in hand and are essentially preparatory. Research work there is bound to be scrappy, discontinuous and un-co-ordinated. I may be permitted to quote here from an article by Dr. Lee A. Dubridge who is now President of the California Institute of Technology and who during the War was Director of the Radiation Laboratory at Massachusetts Institute of Technology which had such a lot to do with the conduct of atomic energy development in the U.S.A. Discussing the importance of large research laboratories, Dr. Dubridge says "... it should be clear that independent laboratories will have as their major facilities only those very large installations which, as far as can be foreseen, are beyond what a single university could contemplate operating—or which, because of shortage of material or funds, not more than one or two universities in any area could have. So I, for one, look forward with keen interest to a great new experiment in physical research. Those who long for the old days with lone worker in the damp basement room with his wax and string and glass-blowing torch can have them. I believe that the essential spirit of the old days—freedom of enquiry and time for thought—can be obtained even in the pressure of great new physical and organisational techniques". It is a fact that fundamental research itself has now become a huge organised industry in itself.

Many problems of industry and even pure physics are such as require for their solution

the technique of more than one branch of physics and sometimes calls for team-work in all the branches. A collection of experts in the various divisions will make this team-work a possibility in this Laboratory. The first experience of the success of team-work in science was noticed during the War. Its application to industry and human progress has still greater possibilities. India's youngmen are full of enthusiasm for service and the National Laboratories provide a fertile field of work for them, provided their basic education has been sound and distinguished.

The Council of Scientific and Industrial Research has several endowments given to it by industry. The magnificent gifts of Rs. 11.70 lakhs for the National Metallurgical Laboratory and Rs. 8.30 lakhs for the National Chemical Laboratory from the Tata House, Bombay; Rs. 1 lakh from Sir Inder Singh of Indian Wire & Steel Products for the National Metallurgical Laboratory; Rs. 15 lakhs from Dr. Alagappa Chettiar; Rs. 15 lakhs from the Silk Industry and numerous other donations of land and money are indicative of a rising conviction amongst industrialists in India that they must help Science. The greatest achievement of which the Council of Scientific and Industrial Research and the Department of Scientific Research can be justly proud is that they have succeeded in creating enthusiasm amongst young Indian scientists for dedication of their lives to research and an awakening amongst industrialists that their work of service can be helped by science. At no time in the history of India was this enthusiasm so great as now and this can be directly traced to the keen interest our gifted Prime Minister has taken in the progress of Science and Technology. His last speech urging upon Industrialists to speed up their interest in science has evoked Nation-wide interest and we have heard from a very distinguished industrialist of India in which he promises the utmost help from Industrialists in all directions. I venture to say that a great many problems of poverty, disease and food can be solved if the scientific approach to the solution of these problems is followed up. The politician's method of plotting has failed everywhere. Power and Plenty now come through Scientific Planning. Planning by politicians without Science and Technology degenerate into plotting for political power.

I am glad to say here that these National Institutes will not only help industry, agriculture and commerce, they will also be of direct help to the masses. I have recently prepared a memorandum which I am circulating to all the Directors and Officers-in-charge of the National Laboratories requesting that they should orga-

nise themselves for voluntary service to better the lot of villagers in their neighbourhood by the aid of science. We have proposed that we should select a certain number of villages near the seats of our laboratories and visit them in teams on Sundays and holidays and help the villagers by improving their cottage industries, hygiene and sanitation and their general scientific knowledge by popular scientific talks. These visits from the eleven national centres will be arranged in a regular manner and we expect to raise funds for this help ourselves without going to the Government. There is nothing more infectious than personal contact and we hope this simple experiment will enable us to take science to the villages. We hope to bring into action soon 250 scientists for this purpose.

The participation in this ceremony by our respected Governor-General is a proof of His Excellency's abiding interest in science. Although we have heard that he has decided to relinquish his high post, His Excellency will always be our Rajaji and continue to occupy a position of honour and respect in our minds. The presence of our National Heroes, Pandit Jawaharlal Nehru and Sardar Vallabhbhai Patel, on this platform augurs well for the success of science in India. I recollect with great interest the reply I received from Mahatma Gandhi

when I sent him two couplets on our National Flag.

The English translation of the lines were:—

The National Flag is also a symbol of freedom and every nation has its own flag,

The unfurling and waving of which sends a thrill of joy through the hearts of the people,

Those who are followers of Mahatma Gandhi must of course remain peaceful but they should remember,

That underneath every National Flag that flies high is a strong rod and staff.

Mahatma's wit and humour are proverbial. He wrote to me to say that he had succeeded in creating a National Flag and he left it to the scientists to create a rod which will hold the flag firmly.

With your help, Sir, our respected leaders, we hope to create the rod and staff which will hold our flag high. The presence of the greatest living Chemist, Sir Robert Robinson, and his distinguished wife and the galaxy of foreign scientists, Cordon of the U.S.A., Bernal of U.K., Englehardt of the U.S.S.R., Auger of the United Nations Organisation, Rydbeck of Sweden and others is nothing else but an indication of India's desire to move in unison with the rest of the world at best in the domain of science.

DIRECTORY OF CULTURE COLLECTIONS OF MICRO-ORGANISMS MAINTAINED IN INDIA

UNDER the auspices of the Indian National Committee on Type Culture Collection of Micro-organisms, it is proposed to issue a Directory of the Culture Collections of Micro-organisms maintained at various centres in India, including those in possession of individual specialists. In order to make this document authoritative, comprehensive and complete, the active co-operation of all microbiologists and others interested in type cultures of micro-organisms, is earnestly requested.

You are invited to send in the information to the undersigned before 31st March 1950, covering (1) the name of the Institution, (2) name of the investigator in charge, (3) nature of the collection, (4) objects of the collec-

tion, (5) lines of research, if any, connected with the collection, and (6) number of micro-organisms classified under (a) viruses, (b) bacteria, (c) yeasts, (d) fungi, (e) algæ, (f) protozoa, and others.

M. SREENIVASAYA

Convener,

Indian National Committee on Type
Culture Collection of Micro-organisms.

Section of

Fermentation Technology,
Indian Institute of Science,
Bangalore 3,

February 22, 1950.

PAPYROGRAPHIC* STUDIES IN NITROGEN METABOLISM OF MICRO-ORGANISMS

Part I. A Critical Study of the One-Dimensional Micromethod of Papyrography for the Analysis of Protein Hydrolysates

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(Section of Fermentation Technology, Indian Institute of Science, Bangalore)

IN the course of our studies on the nitrogen metabolism of micro-organisms in relation to their mitotic cycle, we were faced with the problem of partitioning the nitrogenous constituents of the cell. Two other studies which presented the same problem were, (1) the amino acid make up of the malarial parasite and (2) the biological efficiency of the silkworm as a converter of the feed protein into silk protein.

The choice of the method would naturally be influenced by its simplicity, speed and ability to deal with micro quantities of the research material. Papyrography originated by Consdon, *et al.*,¹ offers a suitable method and meets most of the requirements. But, in view of the acute shortage of the essential solvents and developing reagents in this country, we have been obliged to prefer the one dimensional micromodification of Rockland and Dunn,² which has been shown to be suitable for the analysis of amino acids in microgram quantities.

It was of interest to examine if this method could be extended for the detection, separation and estimation of amino acids in protein hydrolysates. The scheme entailed a study of (1) the choice of more effective solvents securing better resolutions of the mixture, (2) the standardisation of the experimental conditions, e.g., quantity of mixture under test, pH, temperature and time of experimentation, (3) conditions for development of colour with ninhydrin and (4) the influence of polypeptides, sugars and other interfering substances associated with hydrolysates of tissues and tissue fluids.

Experimental.—Test tubes 6" × 1/2" with 0.5 ml. of the solvent mixture for developing the chromatogram and filter-paper (Whatmann No. 1) strips measuring 135 mm. × 15 mm. tapering to 10 mm. assembled as in Fig. 1 were used for all the experiments. Later for obtaining better resolutions of the mixture, flat

bottomed test tubes 8" × 1", 1 ml. developing solvent mixture, and filter-paper strips 180 mm. × 20 mm. tapering down to 15 mm. were used. Solvent mixtures employed consisted of (1) phenol saturated with water,¹ (2) *n*-butanol saturated with water and (3) *n*-butanol saturated with aqueous acetic acid.³

The colour is developed with ninhydrin by spraying a solution of the reagent (0.1 per cent.) in *n*-butanol on the filter paper strip after developing the chromatogram.

Different mixtures of pure amino acids, 0.01M solutions and casein hydrolysate, 5-10 mgm. nitrogen/ml. have been used in the course of these studies. 0.5 to 1.0 μl of the solution is delivered by means of capillary pipette at a previously marked spot (see Fig. 1). Care is taken to secure

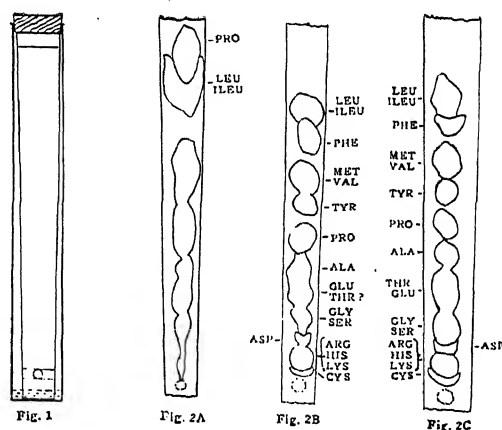


FIG. 1. Diagram showing strip in position for developing. The strip is fixed to the cork stopper by a pin. The solvent travels upto the line near the top.

FIG. 2 A.—Reproduction of Papyrogram of Casein (Acid) hydrolysate developed with phenol in small strip.

FIG. 2 B.—Reproduction of Papyrogram of Casein (Acid) hydrolysate developed with *n*-butanol / acetic acid in small strip.

FIG. 2 C.—Reproduction of Papyrogram of Casein (Acid) hydrolysate developed with *n*-butanol / acetic acid in longer strip.

(Abbreviations according to Brand and Edsall, ¹⁷)

* "Papyrography," a suggestive and appropriate term proposed by Dent⁶ for partition chromatography on filter-paper is used throughout this paper. Also the word "Papyrogram" is used to denote the map after developing with ninhydrin or other reagents.

a clean circular spot with a diameter not exceeding 2 mm. If the solution happens to be too dilute, the application of the solution at the spot may be repeated after drying out the previously applied solution.

An ascending distance of 125 mm. in the case of the small test tube and a distance of 160 mm. in the case of the bigger test tube are marked and the developing solvent generally takes about 2.5 hours and 4 hours respectively to attain these heights. After development of the column the strips are air dried, sprayed on either side with 0.1% solution of ninhydrin in *n*-butanol and oven dried at 100° C. for 10 minutes with a view to develop the colour. The strip is then viewed both by transmitted and reflected lights and the coloured areas marked with a pencil.

The R_f values¹ of individual amino acids both for phenol and for *n*-butanol/acetic acid were determined when run as single amino acids and also when present as simple mixtures and in protein hydrolysates. The R_f values of a few simple dipeptides have also been determined.

Our experience with phenol has not been very satisfactory for the separation of amino acids. The solvent is corrosive; the spots become diffuse and merge into one another.

n-Butanol saturated with water is found very unsatisfactory since the movement of amino acids was found to be very slow.

n-Butanol saturated with aqueous acetic acid² gives a satisfactory separation with a complex mixture of amino acids. The spots, while some of them certainly represent composite spots of a group of closely related amino acids, were discrete and sharply defined.

With 180 mm. strip, better results were obtained.

Discussion.—Phenol, collidine and such solvents have been reported^{4,5} previously to decompose partially or fully some of the amino acids. As a result of this the spots spread out, a typical example being cystine giving an elongated spot with R_f values 0.25 to 0.5. Dent⁶ has suggested the oxidation of cystine to cysteic acid by H_2O_2 before development. Besides the sensitivity of the ninhydrin reaction for some amino acids also decreases.⁸ Alcohols being comparatively inert, they may be expected to cause no decomposition and this is borne out by our experience.

The R_f values of amino acids are not constant and cannot be relied upon for the identification.^{8,9} Various factors influence the movement of an amino acid in relation to the solvent, e.g., slight change in the quality of the solvent

TABLE I
 R_f Values of individual Amino Acids

Amino Acids	Solvent: Phenol			Solvent: <i>n</i> -Butanol/Acetic acid		
	Authors	Rockland & Dunn ²		Authors		Woiwod ^{3*}
				Small strip	Long strip	
Alanine	..	0.62	0.62	0.34	0.35	0.32
Arginine	0.53	..	0.14	0.11
Aspartic Acid	..	0.05	0.25	0.14	0.19	0.14
Cystine	..	0.25-0.5	..	0.06	0.08	0.03
Glutamic Acid	0.39	0.45	0.26	0.25
Glycine	..	0.48	0.49	0.34	0.2	0.19
Histidine	0.81	..	0.11	0.11
Isoleucine	..	0.89	0.85	0.72	..	0.85
Leucine	..	0.88	0.86	0.69	0.66	0.85
Lysine	0.41	..	0.12	0.11
Methionine	..	0.82	0.74	0.62	0.48	0.62
Phenylalanine	..	0.83	0.87	0.68	0.6	0.76
Proline	..	0.89	0.87	0.41	0.4	0.4
Serine	0.33	..	0.19	0.19
Threonine	0.57	..	..	0.25
Tryptophane	..	0.8	0.81	0.64	0.53	..
Tyrosine	..	0.61	0.53	0.5	..	0.53
Valine	0.82	..	0.47	0.62

* Calculated from reproduction of Papyrogram of mixture of Amino acids taking R_f value of proline to be same as ours.

or the associated constituent in the mixture, the quality of the paper, the degree of saturation of water in the mobile phase, etc. Many of these conditions of experiments can be controlled but occasionally, erratic R_F values were obtained.

It is fortunate, however, that the relative positions of various amino acids are in the same order, irrespective of variations of the individual R_F values. So with a known mixture of some amino acids as reference it should be possible to identify the constituents of an unknown mixture, when run simultaneously. Proline, because of its yellow colour and phenylalanine, because of the bluish purple colour with ninhydrin, constitute convenient reference points.

Martin¹⁰ in a paper to the symposium on Chromatography observes that "in two dimensional chromatograms 1 to 2 micrograms of amino acids could be detected and in single dimensional chromatograms half a microgram can, under favourable circumstances, be observed". From a study of the sensitivity of ninhydrin reaction in papyrography, Pratt and Auclair⁸ finds that 10 of the amino acids studied could be detected in microgram or less quantities, in a two-dimensional run with phenol and collidine. The sensitivity of the test is affected by the spreading of spot that occurs in two dimensional run over long hours and possible decomposition by developing solvents. Hence it could be expected that a short run and less reactive solvents would give a compact spot and increase sensitivity of the ninhydrin reaction. As in all micromethods, the quantity of the mixture to be used should be small, to avoid overloading and freakish development. We have been able to confirm the findings of Rockland and Dunn² that microgram quantities of amino acids could be detected in the microadaptation of the method. Besides we have found that the use of *n*-butanol acetic acid gives a more compact spot, thus aiding better separations and detections in an analysis of mixtures.

Attempts have been made by some^{4,7,11,12} to use other reagents giving colour with specific amino acids. We have also used the Sakaguchi reagent for arginine, Pauly reagent for histidine, Ehrlich reagent for tryptophene and tyrosinase for tyrosene on filter paper strips after development and found them capable of testing microgram quantities. Other specific colour reactions are being tried.

The use of impregnated paper^{13,14} is another development which has proved useful in specific cases. We are experimenting with papers impregnated with starch, silica gel, etc. Prelimi-

nary results give promise of better development on starch impregnated papers in the form of sharp or compact spots though no difference could be found in separation.

Little work has been done on peptides separation,^{15,16} by papyrography. Available peptides have been studied in the 180 mm. strip and the results obtained with leucine, glycine and the dipeptides composed of these two are given below (See Table).

R_F Values of Glycyl-leucine and Leucyl-glycine

	Phenol		<i>n</i> -Butanol/ Acetic acid
	Authors	Consdon, <i>et al.</i> *15	
Glycyl-L-leucine	0.90	0.87	0.65
Leucyl-glycine	0.74	0.86	0.63
Leucine	0.88	0.88	0.66

* Phenol with 0.1% Cupron and by descending boundary method.

With phenol, the leucylglycine occupies the lower half of an elongated spot, while leucine and glycyl leucine occupy the upper half of the spot. With butanol-acetic acid, leucylglycine and glycyl-leucine occupies the lower half of the leucine spot. The two peptides give a brown colour first^{15,16} and so is discernible from leucine in mixed spots. The colour of the dipeptides spot however changes to purple slowly.

Summary.—A critical study of the microadaptation of papyrography has been made and improvements in the use of *n*-butanol/acetic acid as developing solvent and use of a slightly longer strip have been suggested. These improvements increase the sensitivity of the technique due to minimum decomposition and spreading of amino acids. The modified technique has been adopted for a routine qualitative analysis of protein hydrolysates.

Possibilities of extending and improving this technique by use of specific colour reactions for some of the amino acids and by use of impregnated papers with a view to secure better separations are discussed.

We wish to express our grateful thanks to the Council of Scientific and Industrial Research for financing a scheme of which this work forms a part. Our thanks are also due to the Director, Indian Institute of Science, for his kind interest.

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SCIENCE AND COMMONSENSE*

COMMONSENSE is no doubt a highly valued body of knowledge doing excellent service in the ordinary day-to-day affairs of life, but it cannot be claimed that it is in anyway infallible. One might say that the progress of science and mathematics has to a large extent depended on the discovery of the vast regions where the laws born of common experience are no longer valid, as also through the unearthing of the many pitfalls in the process of deductive reasoning on which commonsense generally depends.

There are many laws relating to the motion of terrestrial objects which are quite true in the immediate range and vicinity where we live and these are embodied in the Newtonian mechanics. But these laws break down when they are carried over to the region of very small bodies such as the electron, whose dimensions are of the order of 10^{-12} cm. (that of our own being 10^2 cm. or so) as well as in the region of the interstellar spaces where the order of reckoning is 10^{12} cm. or thereabouts. Thus, while it is possible to define the position and velocity of a terrestrial object such as an aeroplane with sufficient precision so as to be able to hit it, we are not able to do the same in the case of an object such as the electron without introducing an element of uncertainty.

Similarly, in the field of mathematics, there are many examples where the commonsense view comprehends only a very limited domain of the entire body of truth. For instance, the ordinary commutative law: $a \times b = b \times a$, on which commonsense algebra rests, is not universally true, and thus has to make room for the noncommutative algebra, wherein $a \times b$ is not equal to $b \times a$, but quite different.

Also, in the case of velocities approaching that of light, the commonsense aspect has been found to be so inadequate indeed as to have given rise to the Theory of Relativity. According to this theory, the relative velocity of two particles approaching each other, of which the

velocity of the one is u and that of the other is v , is not their sum but may be considerably different, depending on how near their velocities are to that of light.

One more instance where the validity of common experience breaks down is in the province of temperature, where it is well known that all our sensations of life are limited to a few degrees; this way and that of the freezing point of ice. But recent experience has shown that below this range, phenomena take place which need for their comprehension and explanation a modification if not also the abandonment of all commonsense ideas referring to conductivity, resistance, fluidity and so on. To illustrate: We all know that a loop of wire in which an electric current has somehow been introduced soon loses it, by reason of its electrical resistance; but, if the same loop be lowered into a bath whose temperature is in the vicinity of the absolute zero, it has been found that the current in the wire persists for a very great length of time. Obviously enough, the ordinary conception of resistance gathered in the temperature range of biological experience breaks down here.

The case is quite similar in the region of high temperatures also where chemical action is no more a mutual exchange of the outer electrons but assumes the character of nuclear transformation. The reason is pretty obvious; while at ordinary temperatures, the energy of chemical action is far too small to affect the nuclear stability at temperatures near a million degrees or so, the kinetic energy of the participants become comparable to that of the nuclear binding. Thus, we have in the latter case a veritable transmutation of the elements such as no alchemist might have dreamed of.

So, it would seem that the laws needed for a description of natural processes are by their very nature *restricted* to the range for which they hold good, becoming less and less true as we go farther away from that range. Considered in this light, commonsense represents only that body of knowledge which holds good in the range of sizes and dimensions comparable to our own, but breaking down for every other.

* Digest of an Address by Prof. H. J. Bhabha, F.R.S., Director, Tata Institute of Fundamental Research, Bombay, at the Indian Institute of Science, Bangalore, on 14th Feb. 1950.

FRIEDEL-CRAFTS POLYMERISATION

S. L. KAPUR

(Division of High Polymers, National Chemical Laboratory, Poona)

THE use of AlCl_3 and other metallic halides in Friedel-Crafts synthesis of aromatic compounds is well known. When these catalysts are added to such monomers as styrene and its derivatives, or isobutylene, a very rapid polymerization takes place. This polymerization is very sensitive to impurities although the well-known inhibitors like hydroquinone or oxygen have no effect on it. The molecular weight of the resulting polymer is very low and unlike addition polymerization it increases with the rise of temperature. The fact¹ that molecular weight reaches its maximum immediately after start, points it to be a chain reaction rather than a step reaction.

The mechanism of such a polymerization is quite different from that of a free radical polymerization and the nature of the catalyst is indicative of a polar mechanism. The salient features of such type of polymerization are discussed below:

The catalytic activity decreases in the series BF_3 , AlBr_3 , TiCl_4 , TiBr_4 , BCl_3 , BBr_3 , and SnCl_4 . There are certain minimum concentrations of the catalyst and the monomer below which no polymerization takes place. In industry BF_3 is used as the catalyst but in scientific work weak catalysts are used as they are amenable to controlled conditions. No polymerization takes place when thoroughly dried catalysts are used^{2,3}; a third component, usually water or an alcohol is required in small amount.

The monomers in this type of polymerization contain in general an electron rich double bond. Thus substituents in the following typical monomers are of the electron releasing type:— (1) Styrene, (2) α -Methyl Styrene, (3) Isobutylene, (4) Indene, (5) Alkyl Vinyl Ether.

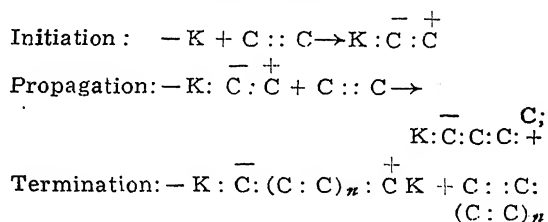
It follows that monomers like vinyl chloride and acrylates which contain electron-attracting substituents cannot be polymerized by such catalysts.

In contrast to inhibition in free radical polymerizations, steric factors play an important role in this type of inhibition. Amines and ethers are some of the typical inhibitors. Amines react with the catalyst to form a complex compound. It has been shown by Brown and Co-workers⁴ that dissociation of the above type of complexes is governed by steric factors. So, it follows that complexes of secondary and tertiary amines with the catalyst will be dissociated to a larger extent than complexes of primary amines. Thus di- and tri-*n*-butyl amines and dimethyl aniline

are about equally effective inhibitors of styrene polymerization while *n*-butylamine is weaker.⁵ This order is however, changed to di-*n*-butylamine, tri-*n*-butylamine, dimethyl aniline and *n*-butyl amine in the polymerization of α -methyl styrene for the likely reason that the reaction between the free amines and chain propagating species (probably a carbonium ion) is also subject to steric hindrance. The α -methyl styrene carbonium ion $\text{R}-\text{C}(\text{CH}_3)\text{C}_6\text{H}_5$ is sterically more hindered than the styrene carbonium ion, which explains the difference in the action of secondary and tertiary amines.

As a consequence of the popular nature of these polymerizations it is to be expected that dielectric constant of the medium strongly influences the reaction, a fact that has been actually observed in the case of α -methyl styrene⁶ and styrene. In the case of styrene, reaction rates show a rapid increase whereas molecular weight is only slightly affected, which indicates that inhibition reaction is strongly favoured while termination is depressed in high dielectric constant media.⁷

Eyring and coworkers⁸ suggested that such a polymerization proceeds through a dipolar intermediate. It is assumed that catalyst merely increases the polarity of the double bond and termination is brought about by the snapping of the catalyst from the chain and they suggested the following mechanism.



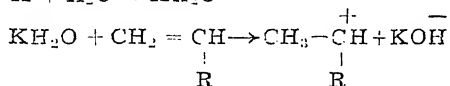
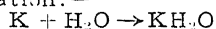
where K denotes the catalyst.

This scheme does not account for the findings of Polanyi and coworkers^{2,3,4} that a co-catalyst is positively required for starting the reaction.

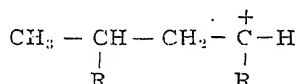
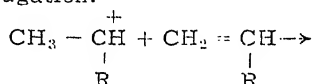
It is clear that if catalyst increases the polarity of the olefinic double bond, BF_3 should be a more effective catalyst than the salt ' $\text{BF}_3\text{H}_2\text{O}$ ' in which the electron accepting capacity of BF_3 is satisfied. This is not the case. Moreover the monomolecular termination (also postulated by Price⁹) should be practically unaffected by a change in the dielectric constant of the medium. George and Wechsler⁷ and others⁶ have very recently shown that termina-

tion is depressed by increase of dielectric constant and all these facts support the mechanism approved by Polanyi and coworkers.

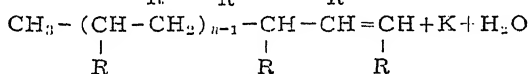
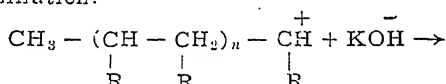
Initiation:—



Propagation:—



Termination:—



The termination being a reaction between oppositely charged ions will be depressed in a medium of high dielectric constant. There is a

note of caution to be observed in accepting this mechanism since we are not dealing with free ions but rather with ion pairs or with potential ions and the proposed mechanism is yet open to criticism.

Progress in this field of polymer chemistry has been slow mainly because of the sensitivity of the reaction to impurities and its high rate in absence of solvents. No reliable kinetic investigations of such polymerizations have been reported as yet.

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4. Brown, H. C. and co-workers, *J. A. C. S.*, 1944, **66**, 431-35; 1945, **67**, 374-78, 1765; 1947, **69**, 1137.
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7. George, J., and Wechsler, H., 'Unpublished results,' Polytechnic Inst., of Brooklyn, New York.
8. Mulburt, H. M., Herman, R. A., Tobolsky, A. V., and Eyring, H., *Ann. N. Y. Ac. Sc.*, 1943, **44**, 371.
9. Price, C. C., *Ibid.*, 1943, **44**, 351.

ADVANCES IN MICROBIOLOGY*

MICROBIOLOGY has now come of age; separate Research Institutes for the study of microbiology have been founded and the latest in the field is the one organized by Professor Waksman. The rapidly accumulating wealth of fundamental knowledge and the spectacular growth of industries based on the discoveries made in the field of microbiology, have hastened this happy recognition of microbiology as an independent and well-defined branch of science. Microbiology has, in recent years, invaded the fields of genetics, nutrition and intermediary metabolism and micro-organisms have continued to provide for fundamental studies a convenient unicellular unit of life of unexpected flexibility and resourcefulness.

It was inevitable that such a rapidly growing and fruitful branch of science should result in the birth of the *Annual Review of Microbiology*—the third in the lineage of the brilliant family of Annual Reviews.

Seventeen reviews encompassing the morphological, cytological, genetical, immunological, pathological, chemotherapeutical, epidemiological, nutritional, biochemical, medical and industrial facets of microbiology, have been presented

in the first volume by a group of top-ranking and active workers. Of the 17 contributions, thirteen are from the laboratories of the U.S.A., three are from England and one is from France. The total number of references to literature cited in the volume is nearly 2,000.

Protozoa, fungi, bacteria and viruses are all covered. Investigators interested in the various aspects of protozoal diseases including malaria will find the four contributions, morphology and cytology of protozoa by Wenrich, antigenic variation in protozoa by Harrison, life cycle of malarial parasites by Huff, and the problem of growth factors for protozoa by Lwoff, extremely stimulating and suggestive. Those interested in nutrition and intermediary metabolism will welcome the contributions of Woods and Gale on Bacterial Metabolism and Nitrogen Metabolism. Benedict and Langlykke have reviewed the evergrowing field of antibiotics, while the important aspects of Industrial Fermentations are covered by a review by Johnson. The review on chemotherapeutic agents by Lourie constitutes a thought provoking article which will serve to stimulate and rationalise chemotherapeutical research. These reviews have a much wider appeal than what may be apparent from the title. By the publication of the new series of reviews devoted to microbiology, the Annual Reviews Inc. have earned the gratitude of a wide circle of investigators.

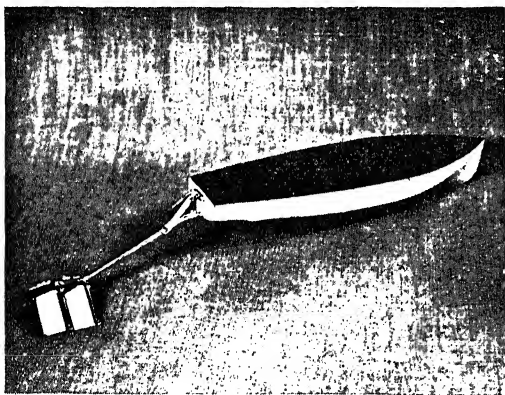
* *Annual Review of Microbiology*, Vol. I. Edited by Charles E. Clifton, Sidney Raffel and H. Albert Barker. (Annual Reviews Inc., Stanford, California), 1947. Pp. vii + 464. Price \$ 6.00.

SHIP PROPULSION BY WAVE MOTION

A NEW method of driving a ship by wave motion has been invented by Mr. Sydney McCubbin of Black Rock, Melbourne, by utilising power obtained from the surface waves of the sea. His invention consists of a loaf or fin of suitable dimensions and materials, flexibly attached, or hinged to the craft, the free edge moving in a suitable arc. A spring tension is provided at, or near the hinge. When the unit lies beneath the surface at the end of an arm, a forward thrust is created by the combined factors of the rise and fall of the water, resistance of the water to the fin, and the return action of the fin.

The angular positions assumed by the leaf are proportionate to the pressure applied, to the resistance of the water, and to the return tension of the leaf.

Mr. McCubbin explains that it is the forward thrust which can be utilised to obtain power from the surface waves of the sea for the propulsion of various forms of water-craft. Single or multiple wave units may be attached to these craft in such a manner that advantage can be taken of the difference of the relative vertical or oscillating motion of the sea surface, and of the wave unit. The inventor says that his observations of a tadpole or a fish when swimming showed him that the tail did not merely move, but it also developed a true wave form. This started from the nose and flowed smoothly with increasing amplitude (not frequency) to the end of the tail.



Model craft embodying the wave propulsion unit. The tension at the hinged edge returns the leaves to their neutral position after being moved in either direction by the action of the water.

Detailed study of the wave form of movement showed Mr. McCubbin that the bodies of fish of conventional shape assumed the form of a full cycle on a horizontal plane. A tadpole at rough estimate assumed the form of a cycle and a half, but without special equipment it was

difficult to judge this accurately. On the other hand the wings of a bird covered about a fifth or a sixth of a cycle only. The wings of insects in most instances had a greater cycle coverage than the wings of birds.

A special wave-propulsion raft could be designed to be incorporated in ships' equipment and used to aid survivors of wrecks. This raft would be of conventional construction, except that it would be fitted with special arms, carrying at their ends flexibly mounted fins, or leaves. These could be so arranged that the oscillating motion of the raft, due to the action of the waves, would cause the leaves to rise and fall. Thus moved from their normal position horizontally in the water, the deflection of the leaves would impart a forward thrust to the raft.

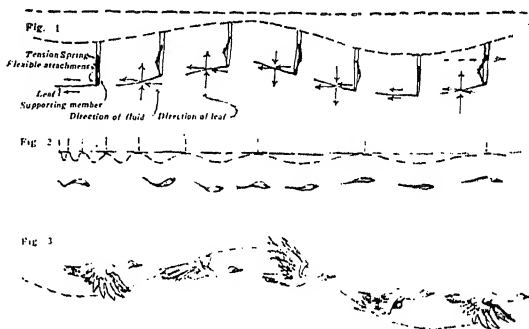


FIG. 1 shows the flexible attachment of the boat which, by reason of its movements, creates the wave form. FIGS. 2 and 3 illustrate the similarity of the wave forms of a fish and a bird. The wave form from the fish's nose flows with increasing amplitude to the end of its tail. The bird adapts its wings to different speeds by a simple variation of pitch.

When not in use the leaves could be folded along the sides of the raft, where special cavities could be provided to receive the more easily damaged members of the unit.

Mr. McCubbin states that his experiments with model boats had also convinced him that wave propulsion could be used to illuminate marine beacons. A pear-shaped buoy ballasted to float in water could have a number of flexibly mounted leaves (wave units) arranged horizontally around and near the top of the buoy, but below the surface of the water. When the water was agitated the buoy would rotate a central spindle (held stationary by a vertical vane), and would enable a generator to charge self-contained batteries and supply current to the beacon. The beacon could be anchored in one spot by a cable attached to the base of the stationary vane and anchorage point.

(By courtesy of the Australian
High Commissioner in India)

PHYSIOLOGY OF HEALTH AND PHYSICAL FITNESS*

IN the course of his presidential address, Dr. Kalidas Mitra emphasised the importance of health, as a natural asset, contributing to the prosperity of any country either agricultural or industrial. Unfortunately physiological research had received scant attention and had not evolved a satisfactory standard for positive health and fitness. Lack of co-ordinated and active collaboration among workers in physiology, hygiene, clinical medicine and public health has been responsible for this unhappy state of affairs; the clinician being interested in cure and the public health worker in prevention of disease are both in a position to pose a number of problems for the hygienist and the physiologist. Another important cause is the racial and genetic complexity of the human organism. Therefore it is difficult to determine absolutely precise health standards for all men. For all practical purposes, the health and fitness of an individual is the degree of adaptation to rapidly changing environments without appreciable loss in power of performance, or if at all the rate

of recovery. A standard of this order would go a long way.

In the last few decades nutrition has been taken as an important factor in the creation and maintenance of health. From the observations derived from the prisoners of war camp and other sources, during the recent wars the clinical symptoms attributed to mal or under-nutrition are not uniform in all cases. The study of physiology of industrial workers and defence personnel of various categories have considerably advanced particularly in America and the results have largely contributed to the welfare and efficiency of the workers and to an improvement in the performance of military personnel. The author bases the criteria of good health on physique, organic efficiency, and motor fitness, i.e., around body development and height-weight ratio, muscular power, and efficient cardiovascular mechanism, vital capacity and sound condition of the body fluids, particularly blood and its constituents. These data should be combined with the findings of a thorough clinical examination. The author concludes by offering a few suggestions for future work. The author who is a public health worker has taken some pains to collect data for this address.

Dr. K. P. MENON.

* Presidential Address by Dr. Kalidas Mitra, M.B., D.P.H., D.T.M. & H., F.N.I., at the Medical and Veterinary Section, Indian Science Congress, 37th Session, Poona, 1950.

PROBLEMS AND PROSPECTS OF INDIAN ANTHROPOLOGY*

IN the course of his presidential address, Dr. C. von Furer-Haimendorf emphasised the need for the co-ordination of anthropological and archaeological research in India. He indicated how certain geographical conditions in this country have made possible the co-existence of diverse cultures from the semi-nomadic food gatherers to the city dwellers. The earlier civilizations have avoided conflict with advanced civilizations by isolating themselves in refuge areas.

Most of the aboriginal cultures represented to-day by forest tribes who are given to shifting cultivation without the use of the plough or wheeled transport could be correlated, according to Dr. Haimendorf, to the early neolithic civilizations of South East Asia exemplified by the Brahmagiri stone axe culture and characterized by the use of partially or wholly polished stone axes with pointed butt and oval cross-section. Here lies the importance of

Dr. Wheeler's excavations at Brammagiri which have enabled us to date not only the megalithic culture of South India but also the preceding neolithic and chaeolithic culture strata. Dr. Haimendorf considers that the Brahmagiri stone axe people had a culture resembling that of the present day aboriginal populations of shifting cultivators. He also considers that the megalithic builders of South India who succeeded them were probably Dravidian-speaking peoples established in South India late in the first millennium B.C.

The latter part of his address considers the value of anthropology for the solution of the socio-economic problems of primitive peoples. Social planning for the development of backward areas should be based on sound anthropological knowledge which has been useful in the rehabilitation and education of the aboriginals of Hyderabad. In conclusion Dr. Haimendorf said that it was gratifying to find that anthropology is being applied to establish better racial relations among peoples and to promote international goodwill.

* Summary of the Presidential Address to the Section of Anthropology and Archaeology, Indian Science Congress (1949), Poona.

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TOSENSITIVITY OF NEON E POSITIVE JOSHI EFFECT

has reported a 3-14% lowering
ig voltage" of the GEC neon lamps
ence of their irradiation by exter-
effect being greater with blue than
yellow light. Such a result is to
from the well-known Joshi effect
media excited by electrical dis-

2,3 showed (i) that the conducti-
under discharge is determined in
excess of the operative potential
shold value, and (ii) that photo-
ion occurs from an electrode layer
leading to enhanced conductivity.
of the threshold potential under

light is thus implied in his theory. As, how-
ever, electron emission from the solid-gas
boundary layer is involved, it follows, that the
phenomenon will be independent of selective
light absorption by the gas phase³, and that
the extent of lowering of the threshold poten-
tial will be in the order of frequency of the
light employed, being determined by the excess
energy of the incident photon over the work
function of the layer which is known to be
small enough to render even visible light effec-
tive.^{3,4,5}

Thus, a lowering of the starting potential due
to irradiation of the type observed by Om
Prakash¹ follows as a primary consequence of
Joshi's theory in all systems, unless secondary
processes, such as, the formation of negative

ions, space charge sheath, etc., are superimposed on the photoelectric emission. The occurrence of these secondaries leads to the production of the familiar negative Joshi effect, now observed in almost all the permanent gases, metallic and other vapours, elemental and compound.^{6,7,8} Joshi generalised⁹ that low exciting potentials as near the threshold condition, should favour the positive effect. This last amounting to several hundred per cent. increased conductivity under light, and accompanied as is to be anticipated, by a marked lowering of the threshold potential, has been observed in several systems as hydrogen,¹⁰ air,^{8,11} and iodine vapour¹² in these Laboratories. It is surprising that Om Prakash should have made no reference to these findings while describing what is but the positive Joshi effect in neon.

Chemical Laboratories, H. J. ARNIKAR.
Benares Hindu University,
December 22, 1949.

1. On Prakash, *Curr. Sci.*, 1949, **18**, 400. 2. Joshi, *Ibid.*, 1939, **8**, 548, and 1940, **9**, 535. 3. —, *Presid. Address Chem. Sect., Ind. Sci. Cong.*, 1943. 4. Deo, *Proc. Ind. Acad. Sci.*, 1949, **23**, 23. 5. Tawle and Gopalakrishnan, *Ibid.*, 1949, **29**, 171. 6. Deshmakh, *Jour. Ind. Chem. Sec.*, 1947, **24**, 211. 7. Prasad, *Nature*, 1949, **164**, 69. 8. Arnikar, *Proc. Ind. Sci. Cong., Phys. Sect.*, 1949, *Abstr. Nos.* 13 and 14. 9. Joshi, *Curr. Sci.*, 1947, **16**, 19. 10. Arnikar and Agashe, *Proc. Ind. Sci. Cong., Phys. Sect.*, 1950, *Abstr. No.* 62. 11. Visvanathan and Rao, *Proc. Ind. Acad. Sci.*, 1949, **29**, 117. 12. Deshmukh, *Ibid.*, 1949, **29**, 243.

THE ABSORPTION SPECTRUM OF ANISOLE

THE ultra-violet absorption spectrum of anisole consisting of about 150 bands was photographed in the region λ 2860–2400. Similar to the Sponer-Wollman interpretation of monosubstituted benzenes, this system can be interpreted as due to the forbidden $A_1 \rightarrow B_1$ electronic transition, allowed as a result of the reduction in symmetry of the benzene molecule from D_{6h} C_{2v} due to the substitution of OCH_3 . The (0, 0) band is located at ν 36401. Bands corresponding to the Raman frequencies of 264, 505, 610, 816, 991, 1021, 1066 and 1297 cm^{-1} were identified towards the red end of this band. Analysis of the bands lying to the violet end led to the identification of the upper state frequencies of 481, 516, 755, 938, 950, and 1261 cm^{-1} . Fairly strong bands associated with the 0, 0 as well as the other intense bands are interpreted as giving the difference frequencies of 86, 56 and

128 cm^{-1} combinations have been found between these frequencies and the fundamental, and other combination frequencies.

A full report of the analysis and the assignment of the frequencies will be published elsewhere.

Physics Department, K. SREERAMAMURTHY.
Andhra University,
Waltair,
December 30, 1949.

BLACK SAND CONCENTRATES OF VIZAGAPATAM COAST

THE study of the beach sands of the Vizagapatam-Waltair coastal area has been extended in the present studies from beyond Waltair to Bhimilipatam further north on the coast through a distance of about 15 miles. The sea-coast is fringed by hill ranges consisting mainly of khondalites, intruded by pegmatites and in a few places by charnockites. The black sand concentrates in this area are far more extensive than in the Vizagapatam-Waltair beach area. Wide spreads of these occur in different places, and attempts were made to roughly estimate the reserves of the black sands now available, to a depth of about 5 feet from the surface. The dimensions of the black sand concentrates vary from place to place, the biggest being about 500 feet by 100 feet with a thickness of 8 inches. The pits put down in the beach to a depth of 5 feet reveal several layers of black sands from about an inch to 8 inches in thickness.

The beach between Kailasa hill promontory to Bhimilipatam can be divided into three distinct units. The first, from the promontory to Erdada village, a distance of about 4 miles, comparatively barren of black sands; the second, from Endada to Dibbalapalem—a distance of 5 miles—with red garnetiferous sands predominating, and the third and last strip, to Bhimilipatam, where black sand concentrates occur in great profusion. It has been estimated that the total quantity of the black sands in the area is 740,000 cubic feet. Of this, in the bulk samples (averaging both the richer and poorer concentrates) magnetite is 36%; garnet, 15%; ilmenite, 5.3%; monazite, 3%; and zircon is 0.6%.

In the richer black sand concentrates, however, monazite is over 8% and ilmenite, about 14%. It is quite easy to define along the beach, the areas where patches contain richer concentrates of monazite and ilmenite. It has been estimated that in sands in this area, there are

about 37,000 tons of magnetite, 12,500 tons of garnet, 5,700 tons of ilmenite, 3,100 tons of monazite and 550 tons of zircon down to a depth of about 5 feet from the surface.

On account of the fluctuations in the beach configuration, there is a certain amount of redistribution of the concentrates. Nevertheless, the estimates given here are claimed to be conservative and of the right order of magnitude. It may be pointed out that annually the streams add a considerable amount of black sand concentrates during the monsoon months, which are sorted, graded and deposited on the beach. The black sand concentrates extend much further down to depths and the yield will be considerably greater, in case exploitation of these rich and important deposits is initiated.

A detailed paper embodying the results of the study will be published elsewhere by one of us (B.N.).

Geology Dept.,
Andhra University,
Waltair,
December 24, 1949.

C. MAHADEVAN.
B. NATESWARA RAO.

1. Mahadevan, C., and Sri Ramadas, A., "Monazite in the Beach Sands of Vizagapatnam District," *Proc. Ind. Acad. of Sci.*, 1948, 27, 275-78. 2. Mahadevan, C., and Sathapathy, N., "The Hons of Monazite in the Vizagapatnam Area," *Curr. Sci.*, 1948, 17, 297.

A COMPARISON OF MT. ABU TEMPERATURE OBSERVATIONS RECORDED AT 1700 HRS. I.S.T. WITH THE FREE AIR TEMPERATURES OVER JODHPUR AT THE SAME LEVEL

IN this note, the Mt. Abu temperatures (and also humidities) have been compared with the free air temperatures (and humidities) recorded over Jodhpur. The comparison, although not very precise on account of the stations not being quite close to each other (distance 115 miles*) and the observations not being exactly synchronous, gives a fairly good idea of the corrections to be applied.

Free air values of dry bulb temperatures at Jodhpur corresponding to the level of Mt. Abu, i.e., 1.2 km. above sea level, were picked up from the daily tephigrams prepared from the radio-sonde ascents made at about 2000 hrs. These were directly compared with the Mt. Abu 1700 hrs. observations, no correction being applied for the time interval between the two sets of observations as it was never more than 4 hours and as the diurnal change in the free air at 1 km. above ground is negligible.

The frequency distribution of seasonal differences of free air and mountain temperatures has been shown in Fig. 1.

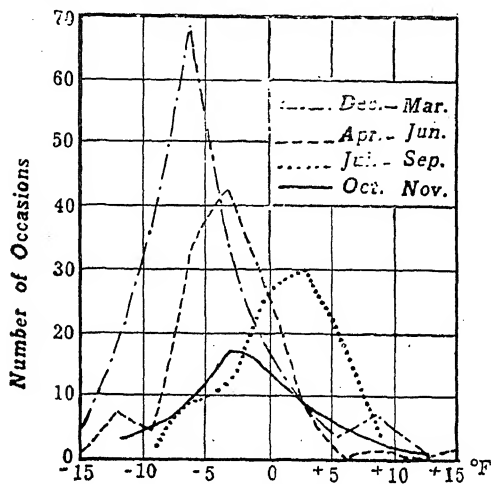


Fig. 1. Free air (J) minus mountain (M)
DRY-BULB TEMPERATURE.

It will be seen that:—

- (a) each of the frequency curves has a sharp peak indicating thereby that the differences are mainly and closely distributed round the mean value and are not scattered haphazardly,
- and, (b) the number of observations is fairly large and well distributed throughout the year.

Wet bulb temperatures and relative humidities were also compared in the same manner as the dry bulb temperatures.

The results have been shown graphically along with that of dry bulb temperatures in Fig. 2.

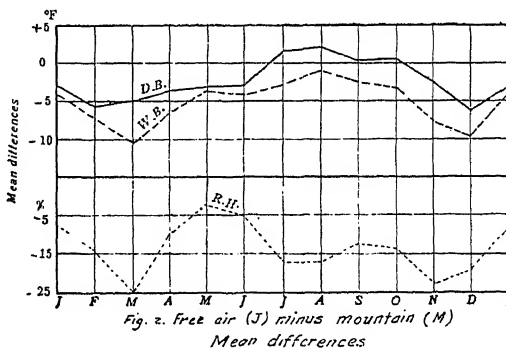


FIG. 2

The mountain is warmer than the free air except in the monsoon months. This result is

opposed to that found in the case of Cherat-Peshawar comparison¹ as the latter was in respect of 0800 hrs. in the morning. The wet bulb temperatures are higher over the mountain throughout the year more so during the post-monsoon and winter period. The relative humidities are also higher over the mountain throughout the year, the differences being less during summer.

Conclusions:

The following conclusions may be drawn from the results:—(i) To reduce the Mt. Abu afternoon temperatures to free air temperatures, it is necessary to apply a correction of -5°F. in winter, -3°F. in premonsoon, $+1.5^{\circ}\text{F.}$ in monsoon and -1.5°F. in the post-monsoon period,[†]

(ii) For wet bulb temperatures an approximate correction of -7°F. may be applied during the period of October to March, of -4.5°F. during pre-monsoon period and -2.5°F. during the monsoon period,

(iii) For relative humidities a correction of -15% may be applied throughout the year except during the pre-monsoon period when a correction of only -5% is necessary.

Regional Met. Centre,
New Delhi,
January 31, 1950.

K. L. BHATIA.

* This is rather high as compared with the distance of 30 miles in the case of Cherat-Peshawar comparison by the author.¹ However, it is much less than the distance (of more than 250 miles) in the case of Simla-Agra comparison by Harwood.²

† The year has been divided into four seasons as follows:—

- (1) Winter—December to March.
- (2) Pre-monsoon (summer)—April to June.
- (3) Monsoon—July to September.
- (4) Post-monsoon—October and November.

- 1 Bhatia, K. L., *Ind. Met. Dept. Sc. Notes*, 10, No. 116.
- 2 Harwood W. A., *Mem. Ind. Met. Dept.*, 24, Pt. 6. 182.

STUDIES ON THE REDUCING SUBSTANCES OF SEMEN

Part III. Fructolysis in Buffalo Semen and the Relation of Fructose Content of Semen to the Volume of Ejaculate and Sperm Concentration

In connection with artificial insemination carried out with buffaloes, it was experienced that their semen does not keep as well as bull semen in preservatives like Egg-Yolk-Citrate and Egg-Yolk-Phosphate used for the latter; subsequent studies show that it has a high percentage of

non-fructose reducing substances compared to goat, sheep or bull semen. An investigation was, therefore, started to study the chemistry of buffalo semen with a view ultimately to develop suitable media for its preservation. In this communication is reported the rate of utilisation of the sperm metabolite, i.e., fructose present in ejaculated semen and its relation to sperm concentration/unit volume (Table I), and the relation of the fructose and sperm concentration to total volume semen (Table II).

TABLE I

Sperm concentration (million/ml.)	Fructose (mg./100 ml.)		Fructolysis (in 3 hours)
	Range	Mean	
0-499 *(30)	394±13.3	1015±50	25.3%±2.1
500-999 *(48)	737±16.1	855±35	39.3%±3.0
1000-1499 *(22)	1149±26.1	729±60	59.4%±5.8

* Number of observations.

TABLE II

Volume (ml.)		Fructose content (mg.)	Sperm con- centration (million)
Range	Mean		
0.50-1.00 *(18)	0.84±0.03	6.44±0.65	698
1.01-1.50 *(21)	1.27±0.08	10.90±0.68	924
1.51-2.00 *(15)	1.77±0.10	15.67±0.48	1237
2.01-2.50 *(12)	2.20±0.12	20.75±2.19	1650
2.51-3.00 *(12)	2.78±0.12	25.58±2.50	1686
3.01-6.90 *(21)	4.22±0.06	39.42±2.87	2955

* Number of observations.

The results show that the relations of (a) sperm concentration/unit volume to fructolysis and (b) volume of ejaculated semen to the concentration of fructose are linear, similar to those in the ram and the goat. Also, fructose concentration in all the three species has been found to be inversely related to sperm concentration.

Our thanks are due to Dr. S. Datta, Director, Indian Veterinary Research Institute, for his continued interest in the work.

A. Roy.

Animal Genetics Section,
Ind. Vet. Res. Institute,
Izatnagar,
December 20, 1949.

S. BHATTACHARYA.
S. N. LUKTKE.
P. BHATTACHARYA.

THE TWIN LAWS OF THE PLAGIOCLASE FELSPARS OF CHARNOCKITES

THE plagioclase feldspars occurring in the rock types of the "Charnockite series" collected from various Charnockitic areas in India, from Nilgiris in the South to Orissa in the North, were examined by the Fedorow method, as expounded by Prof. Dr. Max Reinhard.¹ 84 feldspar grains from 34 rock sections were determined. The twin laws showed the following distribution:—

province, except that the Carlsbad law and the Albite-Carlsbad, so often noted in the Effusive rocks and some Plutonic rocks, are typically absent here. These two laws, however, are found in the pigeonite-metadolerite dykes associated with the Charnockites.⁶ But the mineral composition and textural characters of these dykes are very different from the rest of the Charnockite series. All the types of twin laws, here recorded, normal, parallel and complex, are represented in the Norites. (010) as twinning plane is more common in the Char-

Nature of Plagioclase	Percentage of Anorthite	Normal law				Parallel law			Complex law		Rock types as described by Holland
		Allite	Manbach	Baveno right	Baveno left	Carlsbad	Acline = Manbach-Ala	Peridine	Ala	Albite-Ala		Albite Carlsbad
Oligoclase .. 15-25%	..	..	..	..	..	1	..	..	..	..	Acid charnockites
Oligoclase to Andesine .. 25-35%	9	1	..	..	..	4	..	..	8	..	Gneisses
Andesine .. 35-50%	20	..	..	..	..	16	..	..	..	..	Intermediate Charnockites, Gneisses, Norites, Granulites, Amphibolites
Labradorite .. 50-70%	6	2	..	..	..	2	..	..	1	..	Norites
Bytownite .. 70-90%	1	..	..	..	..	..	..	..	1	..	Basic Charnockites
Total of laws	36	3	..	..	..	3	20	..	10	..	
Percentage	39=54%					23=32%			10=14%		

The accuracy of the above determinations was checked by four methods:—(1) by comparing the angles measured between the optic axial planes of two individuals of a grain, with the values recorded by Duparc and Reinhard,² for the various twin laws; (2) by comparing the angles α_1 , α_2 , β_1 , β_2 , γ_1 , γ_2 with the values of Köhler,³ (3) by constructing the extinction angles by the Biot-Fresnel law, from the optical data and cleavage directions measured on the Fedorow stage, and comparing these angles with the values of Duparc and Reinhard,² and (4) by constructing the poles of the twin axes by Nikitins' and Berek's methods⁴ to distinguish normal from parallel and complex laws.

The Albite-ala law is highly developed in the feldspars, which are intermediate in composition between oligoclase and andesine, as noted by Dr. Coulson.⁵ The largest proportion (36 out of 72) of the grains determined is andesine, and the two laws—Albite and Periclinal=Acline are about of equal frequency in this plagioclase. No twin law is distinctive of the Charnockitic

nockite series than (001). In 46 instances, (010) is the twinning plane and in 26 instances (001) is the twinning plane. The width of the albite lamellæ measured from oligoclase to bytownite, in this series, generally accords with the theoretical deductions of Donnay.⁷

On the basis of the plagioclases determined, the Charnockites can be divided into the Acid group with oligoclase to andesine (25 to 35% An.), and the Intermediate group with andesine (35 to 50% An). The gneisses correspond to these Acid and Intermediate divisions. The Norites are of two types:—(1) with andesine (40-50% An) and (2) with labradorite to bytownite. The hypersthene granulites and amphibolites have andesine (40-50% An).

The Charnockite feldspars follow the Deep Temperature optics of Tertsch.⁸ A collective diagram of the (010) poles does not show the wide "strewing" noted in effusive rocks. A amphibolites have andesine (40-50% An).

My grateful thanks are due to Prof. Dr. Max Reinhard, and especially to his assistants,

Drs. O. Grütter and E. Wenk, under whose direction this work was carried out.

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STUDIES ON THE REDUCING SUBSTANCES OF SEMEN

Part II—Relation of Sperm Concentration and Semen Volume to Fructose Content Fructolysis and Methylene-blue

Time Reduction

In continuation of our previous communication¹
on the total reducing substances, fructose and

ascorbic acid present in the semen of buffalo-bulls, rams and goats, we report here the relation of the various seminal characteristics in healthy rams to sperm concentration/ml. (Table I). Their relation to total volume and total number of spermatozoa/ejaculate is presented in Table II.

Table I shows that the rate of fructolysis is linearly related to sperm concentration/ml.; also that with the increase of sperm concentration, the fructose content in the ejaculated semen as well as the methylene-blue reduction time decrease. The relationship between the rate of fructolysis and total sperm/ejaculate (Table II), is practically linear upto a concentration of 3,500 millions. Beyond that range, however, the rate of fructolysis begins to decline, being due, not to the dilution of sperm concentration/unit volume, but to the higher concentration of fructose present. The time taken to reduce methylene-blue declines in a linear fashion when the concentration of spermatozoa is between 683-2,394 million/ejaculate; thereafter the decline is very gradual. But when reduction time is considered in relation to total volume, it has been observed that the methylene-blue reduction time progressively declines when the volume of the ejaculate is from 0.25 ml. to 1.0 ml. The fructose content has been found to bear a linear relation to the total volume.

The various seminal characteristics of the eleven rams used in the trials are presented in Table III. The figures represent the average

TABLE I

Sperm concentration (million/ml.)		Fructose (mg./100ml.)	Fructolysis (in 15 minutes)	MBRT (minutes)
Range	Mean			
0-1999 * (74)	1522 ± 30	818 ± 30	33.3% ± 1.97	35.2 ± 2.39
2000-2499 * (55)	1198 ± 18	773 ± 34	38.8% ± 2.52	22.3 ± 2.57
2500-2999 * (56)	2627 ± 18	726 ± 27	41.2% ± 2.14	20.1 ± 2.19
3000-3499 * (53)	3181 ± 34	633 ± 28	54.9% ± 3.70	13.7 ± 1.44
3500-3999 * (50)	3666 ± 18	651 ± 34	59.2% ± 3.59	12.7 ± 1.01
4000-4499 * (32)	4156 ± 26	633 ± 35	68.5% ± 4.36	12.9 ± 2.29
4500-4999 * (19)	4679 ± 31	580 ± 56	75.1% ± 6.27	8.7 ± 3.18
5000 & above * (14)	5271 ± 89	413 ± 33	90.9% ± 4.28	7.6 ± 1.64

TABLE II

	Range (ml.)	Mean	Total Fructose (mg.)	Fructolysis	MBRT (mins.)	Average total	
						Volume (ml.)	Sperm (million)
Total volume	0.25-0.50	0.41	3.03	53.3%	27.5	..	91
	0.51-0.75	0.63	3.79	74.2%	16.6	..	2073
	0.76-1.00	0.89	5.48	74.3%	14.3	..	3152
	1.01 & above	1.16	7.46	58.6%	19.6	..	3683
Total sperm per ejaculate (million)	0-1000	683	3.39	40.9%	34.0	0.43	..
	1001-2000	1415	4.32	62.7%	22.1	0.61	..
	2001-3000	2394	4.40	79.6%	12.9	0.73	..
	3001-4000	3471	5.09	81.1%	10.9	0.90	..
	4000 & above	4902	6.20	70.8%	9.1	1.05	..

TABLE III

Animal number	1	2	3	4	5	6	7	8	9	10	11
Total volume (ml.)	0.08	0.59	0.70	0.78	0.60	0.61	0.52	0.63	0.94	0.47	0.688
Fructose (mg./100 ml.)	741	477	765	515	351	659	697	838	700	485	774
Fructolysis in 15 minutes (per cent)	59.1	75.9	47.7	77	89.1	47.6	35.7	40.5	65.3	75.2	47.9
MBRT (min. tes)	10.2	11.3	22.8	11.1	8.3	24.1	40.9	25.1	12.3	19.9	19.7
Sperm concentration (million/ml.)	3542	2973	2567	3392	2987	2264	1930	2677	3235	2637	2546

values of estimations carried out during 5 months.

The figures reveal interesting individual variations in the various seminal characteristics. The fructose content is low in some animals, although the volume of the ejaculate is high. Animal 5 is a typical example. The rate of fructolysis is much higher in the samples with low fructose content.

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THE MICROBIOLOGY OF INDIGENOUS PICKLES AND PRESERVES

THE growing interest in the preservation of foodstuffs has inspired us to a systematic study of the organisms associated with Indian pickles and other preserves, prepared by indigenous methods. The results are summarized below.

The 102 samples (made from mangoes, guavas, lemons and other fruits and vegetables)

consisted of 13 jams, 3 jellies, 10 morabbas, 23 sweet pickles, 10 sour pickles, 31 pungent pickles and the rest unclassified. Particular attention was paid to the study of proteolytic, amylolytic lipolytic, saccharolytic and cellulolytic activities of the enzymes involved and the interrelationships that existed among the species were also studied. Metabolic products of all the moulds isolated were tested for their antibiotic or the other activities with a view to understand their preservative or other influences. Systematic investigations carried out in this connection indicate that some of the tested condiments can indeed be used as harmless preservatives.

The microbiological analyses resulted in the isolation of 292 bacteria, 13 species of yeasts (*Saccharomyces* 5, *Schizosaccharomyces* 2, *Torulae* 4 and *Pichia* 2), 2 species of *Actinomyces* and 70 moulds (54 in vegetative form and 16 in sporulated state). The following organisms or their variants were identified:—*B. subtilis*, *B. pabuli*, *B. laterosporus*, *B. lautus*, *B. mycoides*, *B. terminalis*, *B. coherens*, *B. esterificans*, *B. circulans*, *B. platus*, *B. suprarresistens*, *B. amarus*, *B. tritus*, *B. repens*, *B. novus*, *B. mesentericus*, *B. granularis*, some unidentified members of *Brevis* and *Circulans* groups of aerobic mesophilic bacilli, *M. flavus*, *M. luteus*, *M. rosaceus*, *M. varians*, *M. ochraceus*, *M. epidermidis*, *M. conglomeratus*, *M. ureae*, *M. freudenreichii*, *Serratia marcescens*, *E. coli*, *Actinomyces lipmanni*, *Actinomyces griseus*, some species of

Acetobactor, unidentified species of *Sacch-dromyces*, *Torulce*, *Pichia*, *Schizosaocha-romyces*, *Aspergillus*, *Pachytrichum*, *Penicil-lium*, *Syncephalis*, *Catenularia*, *Prophytroma*, *Syncephalustrum* and *Thamnidium*.

A detailed account of these studies will be published elsewhere.

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ANTIBIOTIC PRINCIPLES FROM MORINGA PTERYGOSPERMA

Two antibiotically active fractions have been isolated from "pterygospermin" of

The material could however be conveniently fractioned in high vacuum without appreciable loss in activity (Table I).

Fractions 4 and 5 possess very penetrating smell. They do not give any reactions of thiols nor their solutions show any fluorescence in the ultraviolet light. Detailed studies of these fractions are in progress.

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TABLE I
3.8 gms. of Crude oil (35 lbs. of roots)—fractionated at 10–3 mm.

Fractions*	Temp. of bath in ° C.	Yield in mgm	Micro-analysis†				Activity against	
			C	H	N %	S	<i>S. aureus</i>	<i>E. coli</i>
1	36–40	98.6					inactive	inactive
2	60–4	47.0					do	do
3	94–5	58.4					do	do
4	125–8	75.8	69.85	7.03	6.40	12.61	1 in 2 × 10 ⁵	1 in 2 × 10 ⁵
					6.44			
5	140–1	212.2	65.00	5.29	7.17	20.46	1 in 4 × 10 ⁵	1 in 4 × 10 ⁵
					6.94	20.32	to 5 × 10 ⁵	to 5 × 10 ⁵
6	Residue	3.0 gm.					inactive	inactive

* Fractions 1 to 5 are colourless mobile liquids.

† By Dr. G. Weiler, Oxford.

Raghunandana Rao, et al.¹ which has been found to be heterogeneous. The antibiotic potency of the crude preparation as assayed against *S. aureus*, was found to vary largely with the age of the plant, and to a certain extent with the season of collection of roots. Complete inhibition was observed at dilutions varying from 1 in 40,000 to 1 in 75,000 with different samples.

Chromatographic methods of fractionation employing adsorbents, viz., charcoal, sugar, tricalcium phosphate, etc., led only to a partial success. With tricalcium phosphate, 240 mg. of crude oil gave (1) 60 mg. of a pale yellow oil from the filtrate (active 1 in 60,000 against *S. aureus*) and (2) a reddish brown oil (170 mg.) recovered from the adsorbate by elution with acetone, which was active only in 1 in 20,000.

LORENTZ-LORENZ EXPRESSION AS AN ANALYTICAL CONSTANT FOR OILS AND FATS

THE importance of refractive index measurements in the analysis of oils and fats is well recognised, but no single property is sufficient to establish the purity of any sample; the reason, of course, is that all natural oils and fats are mixtures, the composition of which varies within fairly wide limits, as a result of which the permitted analytical standard for any particular oil or fat also varies over a wide range.

By making use of the Lorentz-Lorenz formula:

$$\frac{n^2 - 1}{n^2 + 2} \cdot \frac{1}{D}$$

which takes into account two specific properties namely refractive index and density, it was thought the limits of the standard could be brought to a narrower range, and further that

TABLE I
Analytical Data for Mustard Oil

Sample No.	B.R. at 40° C.	I.V.	S.V.	Refr. Index (<i>n</i>)	Density (D)	Specific refraction
						$\frac{n^2-1}{n^2+2} \cdot \frac{1}{D}$
1	50.45	99.1	172.3	1.46355	0.90384	0.30618
2	60.85	102.1	172.8	1.46645	0.90542	0.30612
3	60.05	100.1	170.5	1.46595	0.90394	0.30621
4	59.35	105.0	172.7	1.4655	0.90425	0.30605
5	59.75	102.9	175.4	1.4658	0.90470	0.30605
6	59.95	104.9	175.0	1.4659	0.90539	0.30586
7	59.85	104.3	173.0	1.4658	0.90527	0.30584
8	60.65	105.7	172.9	1.4663	0.90560	0.30589
9	59.15	100.3	171.9	1.4654	0.90447	0.30581
10	59.85	104.2	173.5	1.4658	0.90490	0.30597
Accepted Standard	58.5 to 60.5	96 to 108	169 to 176			0.30581 Minimum 0.30621 Maximum 0.30600 Average

(Samples 1 to 4 were prepared in the laboratory from different varieties of seeds, while 5 to 10 were bazar samples which were certified as genuine.)

The mean value for the Lorentz-Lorenz formulæ is 0.30600, and the maximum deviation is ± 0.0002 .

TABLE II
Analytical Data for Groundnut Oil

Sample No.	B. R. at 40° C.	I.V.	S.V.	Refr. Index (<i>n</i>)	Density (D)	Specific Refraction
						$\frac{n^2-2}{n^2+1} \cdot \frac{1}{D}$
1	56.25	94.5	189.4	1.4634	.90880	0.30330
2	55.15	92.0	189.3	1.4627	.90770	0.30330
3	56.25	95.46	190.8	1.4634	.90895	0.30323
4	56.25	94.5	189.5	1.46345	.90856	0.30332
Accepted Standard	55 to 57.5	92 to 101	189 to 195			0.30323 Minimum 0.30332 Maximum

The maximum value for specific refraction of mustard oil in Table I is 0.30621 while the minimum is 0.30581, while the range of values for ground nut oil is very much narrower 0.30332 and 0.30323.

TABLE III

(In order to explore the possibility of its use in detecting adulteration, various mixtures were made and the constants determined which are given in Table III.)

Mustard oil	B. R. at 40° C.	I. V.	S. V.	Refr. Index (<i>n</i>)	Density (D)	Specific Refraction	Calculated Average decrease for 1%
						$\frac{n^2-1}{n^2+2} \cdot \frac{1}{D}$	
Pure	59.85	104.2	173.5	1.4658	.90490	0.30597	
+5% groundnut oil	59.65	103.6	173.8	1.4657	.9052	0.30583	0.000028
+10% "	59.45	103.3	174.9	1.46555	.9053	0.30569	0.000028
+15% "	59.2	102.3	175.3	1.4654	.90550	0.30553	0.0000292
+20% "	59.05	102.3	176.1	1.4653	.90586	0.30536	0.0000305
+30% "	58.7	101.2	178.1	1.46505	.90599	0.30517	0.000027
+40% "	58.35	100.0	180.0	1.46482	.90655	0.30485	0.000028
Accepted standard for oil	58.5 to 59.5	96 to 108	169 to 176				

TABLE IV

(Table IV shows the observed specific refraction for various mixtures and the calculated one for the same mixtures making use of average 0.0000283 decrease for 1% groundnut oil.)

Sample	Observed Sp. Refraction	Calculated Sp. Refraction	Difference
Genuine Mustard oil	0.30597	..	..
+ 5% Ground nut oil	0.30583	0.30583	Nil
+10% Ground nut oil	0.30569	0.30569	Nil
+15% Ground nut oil	0.30553	0.30555	+ 0.00002
+20% Ground nut oil	0.30536	0.30541	+ 0.00005
+30% Ground nut oil	0.30577	0.30573	+ 0.00004
+40% Ground nut oil	0.30485	0.30485	Nil

a quantitative relationship might exist between this constant and the concentration of the adulterant. Both these expectations were realised in the specific cases examined, but obviously more data are required before the limits of standard can be prescribed for general adoption.

In Tables I and II are listed the relevant analytical data for two oils, namely mustard and groundnut, the latter being a common adulterant in the former. Readings for B.R. and density were taken at 40° C. or corrected to this temperature. B.R.: butyro-refractometer reading; I.V.: iodine value; S.V.: saponification value).

A comparison of the figures in Table IV of observed and calculated values shows that the law of additivity is satisfactorily observed implying that a known adulterant can be quantitatively estimated.

The applicability of this principle in detecting adulteration depends upon first prescribing the limits of the standard value. Some idea of this standard may be obtained for mustard oil from Table I last column. With the exception of sample 9 all the rest have values ranging between 0.30584 and 0.30621, with a mean value of 0.30600, the maximum deviation being 0.0002.

If we now turn to Table III it is seen that the specific refraction value for 5% mixture is 0.30583 which is outside the limits but a little close to that of the pure sample; but mixtures of 10% and more adulterant show unmistakably low values away from acceptable standards. At the same time, it must be remembered that the accepted standards for B.R., I.V. and S.V. are such that adulteration even up to 30% cannot be detected by these means.

A full exploitation of the Lorentz-Lorenz expression must await the collection of data for

a very much larger number of samples from different sources.

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STUDIES IN HOST-PARASITE RELATIONSHIP IN UNTREATED CHICKS INFECTED WITH *P. GALLINACEUM*

ROEHL¹ used *P. relictum* infections in the canary for a quantitative evaluation of plasmodicidal activity of drugs. Several other methods have since been elaborated by others for a preliminary screening of potential synthetic antimalarial drugs.² An inherent drawback in the use of avian malaria is that the host and the species of the parasite are different from human malaria and the antimalarial activity of a drug may therefore differ markedly from that observed in human infections. Extensive experience of pharmacologists working in this field have, however, shown that this difficulty can be successfully overcome by testing the same drug on two or more hosts infected by different species of parasites. To set up a satisfactory experiment to test the possible antimalarial effect of drugs in laboratory animals requires a critical balance of several factors. The maximum dose of inoculum (of parasites) consistent with reasonable observational safety should be employed in order to provide adequate concentration of parasites in blood and to secure a prolonged survival period of the infected animal.

Using *P. gallinaceum* and young cross breed country chicks (4-10 weeks old), the rate of parasitaemia by blood induced infection was studied. The strain of *P. gallinaceum* was

maintained in adult chicks.³ Donor blood was drawn by cardiac puncture through a hypodermic needle and citrated saline (2% sodium citrate, 0.9% saline) was used as a diluent so that 16 million parasitised red blood cells are contained in each 0.1 c.c. of inoculum. Intramuscular inoculations have been used throughout the present work.

Blood smears were stained with Leishmann and Giemsa stain and parasite counts have been expressed for 500 rbc. Haemoglobin determinations were also made with the aid of Klett-Summerson photo-electric colorimeter (total acid haematin method being used). The galvanometer scale was calibrated for the iron constituent of chick blood and iron determinations were made by the Wong's method.⁴ Using Klett-Summerson's photoelectric colorimeter using filter number 54.

In order to study the rate of Parasitaemia to varying doses of parasites five experimental series were studied at different times using the dose of inoculum from 10,000 to 100 million parasites per kilogram of body weight of chick. The following features were observed (Fig. 1). The prepatent period was length-

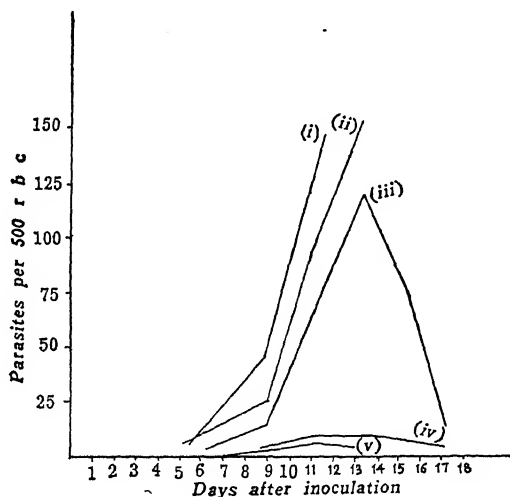


FIG. 1

Dose of parasites per Kg. body weight:—(i) 10^8 ,
(ii) 10^7 , (iii) 10^6 , (iv) 10^5 , (v) 10^4 .

ened with the lowest dose and the resultant infection was variable and the number of parasites seen in peripheral blood was very low, the parasite count being never more than 5 to 10 per 500 red cells at any time. The latent period was from 7-9 days from the date of infection. As the dose of inoculum was increased to about 1 million or more, the prepatent pe-

riod was considerably shortened the rate of parasitaemia being correspondingly increased.

The percentage of deaths and the day on which death occurs bear a direct relationship to the parasite dose. Ninety per cent. of the birds died on the 100 million and 10 million dose groups, and death occurs within 5-6 days, 50-60 per cent. in 1-2 million and 30-40 per cent. in the 100,000 and 10,000 dose groups. When the inocula containing less than 1 million parasites per kilo of body weight are used, the resultant infections are not constant and neither the peak day of infection nor the degree of parasitaemia can be predicted. The lower dose ranges are therefore not satisfactory for standardising procedures. With an optimal of 1-2 million parasite dose a typical curve is obtained for the rate of parasitaemia which is fairly constant for a large group of birds.

The fall in haemoglobin following different doses in general follows the parasite curve very closely in that the severity of anemia is proportional to the degree of parasitaemia. The iron content of the blood (Fig. 2) shows a sudden

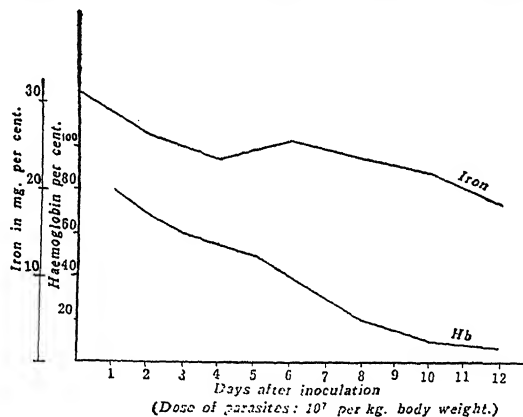


FIG. 2

drop after inoculation and seems to have a temporary rise during the prepatent period. It shows a peak value just on the day before the actual appearances of the parasites in the peripheral blood. This may be due to the production of young erythrocytes in larger numbers in the blood stream. It afterwards decreases following very closely the haemoglobin curves.

For the purpose of standardising procedures for subsequent chemotherapeutic studies on untreated infections in chicks infected with different doses of *P. gallinaceum* have been made. Criteria for evaluation of synthetic antimalarial drugs according to Richardson² are (1) Parasite count at the peak of infection, (2) Haemoglobin concentration on the day following the

peak and (3) morphological changes in the parasites. For qualitative studies on the effect of new compounds to be tested a dose of 1.2 million parasites per kilo of body weight of chicks has been found to be adequate. The suppressive antimalarial activity is shown by lowering of the peak of parasitaemia and flattening of the curve with a shift to the right indicating lengthening of incubation period. The higher doses produce higher rates of mortality and may vitiate the test. Haemoglobin and iron content of blood is particularly of interest as an ancillary evidence of the multiplication of parasites before the actual appearance of parasites in the peripheral blood and of the consumption of the hosts, haemoglobin by the growing parasites.

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ON SAMPLING STUDIES IN THE ESTIMATION OF WHITE FLY INCIDENCE ON SUGARCANE

THE aim of the present note has been to see, if the sampling procedure recommended earlier¹ could be used in estimating the incidence in other whitefly infested fields. The efficacy of

the sampling procedure has been judged on the basis of consistency of the distribution of the errors in the different fields.

An 1/40 acre plot (6 rows \times 20 units) was marked out at random in each of the four fields infested with whitefly at Motihari (Baria Farm) and 15 random units in each plot were completely enumerated, counting all clumps, canes, leaves (dry and green) and the puparia in each affected leaf. Table I given below shows these details.

As there was no sufficient choice of randomisation of clumps in units and canes in clumps, all clumps and canes with five affected leaves per cane were included in the sample for the estimation of the zone variances (units, clumps, canes and leaves being defined as the successive zones).

In the original paper,¹ analysis of variance was done with logarithmic transformation after multiplying each incidence figure by 100, and it was observed that transformation was not essential for the purpose of analysis. Here also, the analysis has been done with the incidence figure as such as also with a similar transformation of the variate. The estimates of the zone variances and these variances expressed as percentages of the total variation are given in the Table II below.

It is noticed that here also the leaves take away by far the largest percentage of variation under both the analyses and that there is also a distinct similarity in the distribution of the percentage variations in the other zones. The conclusion drawn before is therefore confirmed; viz., "the advantage accruing from the transformation is not of such a high order as to offset the extra inconvenience encountered in

TABLE I

Showing total no. of units, clumps, canes leaves, (dry and green) and the percentage of affected leaves

	Plot I	Plot II	Plot III	Plot IV
No. of units	15	15	15	15
No. of clumps	37	41	33	41
No. of canes	92	108	95	92
No. of green leaves	1,046	1,131	1,078	1,009
No. of dry leaves	571	731	735	675
No. of affected green leaves	687	853	746	747
No. of affected dry leaves	115	292	324	243
percentage of affected green leaves on the basis of total green leaves	65.68	75.42	69.20	74.03
percentage of affected leaves on the basis of total leaves	49.67	61.43	59.92	58.10
Mean puparia per sq. inch (sample)	3.29 \pm 0.29	3.15 \pm 0.25	2.64 \pm 0.32	3.11 \pm 0.27

TABLE II

Showing variances due to different zones and percentage errors

	Mean \pm S.E.	S.E. expressed as % mean	Actual zone variance				Zone variances expressed as % of total			
			σ_1^2	σ_2^2	σ_3^2	σ_4^2	σ_1^2	σ_2^2	σ_3^2	σ_4^2
Plot I	.. 3.29 \pm 0.29	8.90	0.8202	0.0964	1.2000	4.3000	12.78	1.50	18.70	67.02
	2.36 \pm 0.05	2.12	0.0257	0.0020	0.0291	0.1250	14.14	1.10	16.00	68.76
Plot II	.. 3.15 \pm 0.25	7.96	0.6708	0.1065	0.0020	5.4900	10.70	1.70	0.03	87.57
	2.33 \pm 0.04	1.82	0.0166	0.0036	0.0134	0.1600	8.57	1.86	6.92	82.65
Plot III	.. 2.64 \pm 0.28	10.60	0.5689	0.6079	0.1500	4.4300	9.88	10.76	2.61	76.95
	2.19 \pm 0.06	2.78	0.0399	0	0.0345	0.1975	14.67	0	12.69	72.64
Plot IV	.. 3.11 \pm 0.27	8.67	0.6764	0.1620	0.4180	6.4200	8.81	2.11	5.44	83.64
	2.31 \pm 0.04	1.68	0.0135	0.0037	0	0.1942	6.39	1.75	0	91.86

The lower figs. have been obtained from the analysis after logarithmic transformation

handling the transformed material". The percentage errors in the four plots (under the analysis without transformation) vary from 7.96 to 10.60. The errors in plots (1), (2) and (4) are 8.90, 7.96 and 8.67, which may, however be reckoned to be of the same order for all practical purposes.

From a comparative study of the percentage errors obtained now and those noticed before, it may be said that the recommended sampling procedure has given more or less a steady estimate of the error percentage, showing thereby the suitability of the sampling procedure for all practical purposes. Further studies on the sampling procedure under severe and low infestation are in progress.

The work was carried out as part of the Sugarcane Research Scheme financed jointly by Bihar Government and the Indian Central Sugarcane Committee to whom grateful thanks are due. Part assistance rendered by Mr. R. C. Acharya in the reduction and analysis of the data is also acknowledged.

K. L. KHANNA.

K. S. BANDYOPADHYAY.

Central Sugarcane Res. Station,
Pusa, Bihar,
December 19, 1949.

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ON "MORELLIN" THE ANTIBACTERIAL PRINCIPLE OF THE SEEDS OF GARCINIA MORELLA DESROUX

THE isolation from the pericarp of *Garcinia morella*, of a crystalline compound "morellin"¹ and an amorphous waxy material has been

reported but no work appears to have been done on the antibacterial principles of the plant. The authors have found that the alcoholic extracts of the seed exhibit marked antibiotic activity when tested by the cup-plate method against *B. subtilis*, the seat of the antibiotic principle being the yellow pigment of the pericarp. On isolation, the crystalline compound was found to be highly antibacterial while the waxy substance was practically inactive.

The antibacterial spectrum of morellin was determined by inoculating 0.01 c.c. of 24-hour broth culture of the test organisms, to tubes containing sterile nutrient broth at pH 7 and morellin at different concentrations,* the volume of total broth in each tube being 5 c.c. The growth of the organisms was observed visually after 18 hours incubation at 37° C. The results are shown in Table I.

TABLE I
Antibacterial spectrum of morellin

Name of organism	Dilution of morellin in broth				Growth in control
	1/75,000	1/100,000	1/150,000	1/200,000	
1 <i>S. aureus</i>	..	-	-	-	+++
2 <i>B. subtilis</i>	..	-	-	-	+++
3 <i>E. coli</i>	..	-	+	++	+++
4 <i>B. typhosus</i>	..	-	-	-	+++
5 <i>B. paratyphosus B</i>	..	-	+	++	+++
6 <i>B. paratyphosus C</i>	..	-	-	+	+++
7 <i>B. dysenteriae</i>	..	-	-	-	+++
8 <i>B. entortidis</i>	..	-	-	-	+++
9 <i>B. aerogenes</i>	..	-	-	-	+++

In the table—indicates no growth; + indicates growth

Results presented above clearly show that at concentrations of about 10 μ g per c.c., morellin completely inhibits the growth of the micro-organisms and partially at lower concentrations.

The pronounced antibacterial properties exhibited *in vitro* by morellin encouraged us to study the toxicity of the drug to mice by a method previously described² for finding the toxicity of allicin and pterygosperrin. Alcoholic solutions (60% alcohol) of morellin were used. To groups of six mice each, doses ranging from 25 mg. per kg. to 200 mg. per kg. were injected subcutaneously. There was considerable necrosis at the site of injection in all the animals, resulting ultimately in death within ten days.

Even at considerably smaller doses such as 2.0 mg. to 4.0 mg. per kg., necrosis of the tissues develops at the site of injection from the fifth day. Morellin thus appears to be highly toxic, and is therefore not likely to assume any importance in chemotherapy.

Our thanks are due to Drs. N. N. De, K. P. Menon and P. L. N. Rao for their suggestions, and Mr. B. N. Banerjee for his interest in these investigations.

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Ind. Inst. of Sci., S. NATARAJAN.

Bangalore 3,

February 6, 1950.

* Though morellin has been reported to be highly insoluble in water, practically clear solutions of the drug in nutrient broth could be obtained at the concentrations used for the studies. The use of the serial dilution method for determining the antibacterial spectrum was thus possible.

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ACTIVE RELAXATION OF UNSTRIATED MUSCLE DURING INHIBITION PRODUCED BY ADRENALINE

SINGH (1944) and Singh and Singh (1946, 1949 a) have described active relaxation of frog's unstriated muscle; Singh, Singh and Muthana (1947) of fowl's gut; and Singh and Singh (1948, 1949 b) of dog's stomach muscle and the human appendix. It has been further found that relaxation of frog's stomach muscle during inhibition produced by adrenaline (1 in 100,000) is active.

The following experimental procedure is used. Transverse pieces of muscle from the cardiac half of frog's stomach are soaked in saline of pH 6.5 for one hour. This acid saline

is used to prevent decomposition of adrenaline and to diminish tone which is antagonistic to active relaxation (Singh and Singh, 1949 b). The muscles are then placed unloaded in a trough containing the saline and their lengths measured. Adrenaline is then added to the saline, and the lengths recorded every 5-15 minutes for one hour.

The muscles begin to actively elongate immediately on addition of adrenaline. Within 5 to 10 minutes they elongate by about 90 p.c., though they further slowly elongate till about one hour, after which they may begin to shorten. The results are shown in Table I. The

TABLE I

Experiment ..	1	2	3	4	5	6	7	8	9	10
Length in saline	21	20	15	15	16	17	16	17	24	22
n m.										
Length in	26	25	17	17	20	22	22	21	26	29
adrenaline 1:100,000 mm.										

muscle may elongate up to about 140 p.c. of its initial length.

Physiological Lab., SUNITA INDERJIT SINGH.
Medical College, INDERJIT SINGH.

Agra,

January 19, 1950.

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INHERITANCE OF SPARSE LINT MUTANT IN COCONADAS COTTON

A NEW instance of major gene control affecting lint quantity is reported here as supplement to the other genes in Cocanadas cotton described elsewhere.^{1,2}

During a survey of the Coconada area (*G. arboreum* race *indicum* H.), two different lint quantity genotypes designated as '1711' and 'CST 1' were spotted and found to breed true. The former possessed a combed length of 10 to 15 mm. and a ginning outturn of 3 to 4% while the latter registered means of 5 to 10 mm. and 6 to 9% for the respective characters. Visual examination of the two types brought out the same differences more clearly. '1711' had sparse lint on an underlying thin coat of fuzz while 'CST 1' had comparatively a denser coat of both lint and fuzz as might be seen from Fig. 1.

The lint samples of '1711' and 'CST 1' did not lend themselves to technological determinations of mean staple length by Ball's sorter or mean

Lint quantity attributes: Mean Values.

Type	Lint length. in mm.	Ginning %	Lint index (wt. of lint in gm. borne on 100 seeds)	Weight of 10 seeds in gms.	Volume of liquid dis- placed by 10 seeds	Weight of lint* borne on x seeds in gm. after ad- justing for size	Remarks
45	.. 22.0	24.0	1.199	0.43	0.35 c.c.	0.1370	Normal lint
1711	.. 10-15	3.6	0.195	0.45	0.40 c.c.	0.0195	Sparse lint
CST 1	.. 5-10	6.9	0.249	0.39	0.30 c.c.	0.0332	Short lint
CST 4	.. 16.0	6.0	0.259	0.24	0.38 c.c.	0.0273	Immature lint

* Weight of lint borne on x number of seeds reduced to a common seed size unit, *i.e.*, seed size equivalent to a volume of 0.4 c.c. of displaced liquid.

fibre weight per unit length. In feel by hand, there was no difference between the two and

another new addition to old world cotton group from the highly variable Coconada centre.

R. BALASUBRAHMANYAN.

Agricultural College V. SANTHANAM,
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Coimbatore,
December 5, 1949.

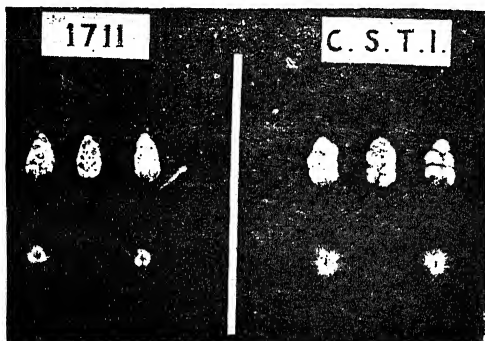


FIG. 1

hence their fibre weights might be presumed to be the same. The lint quantity values of '1711', normal linted strain 45 and two other mutants, *viz.*, 'CST 1' and 'CST 4', found in the same area are furnished in Table I after reducing them to a common seed size group. The values of the three mutants are on the low side due to existence of major differences in fibre properties like density, staple length and maturity but not in seed weight. Consequently conclusions based on ginning per cent will be equally valid for lint index. On an *a priori* basis, it would be justifiable to call '1711' 'sparse-lint' being the lower of the two and to name 'CST 1' 'short lint' on account of its higher density and shorter length.

The segregation obtained in the cross, '1711' 'sparse lint' with normal '45' was monofactorial for ginning per cent giving 85 normal and 24 'sparse lint' in the F_2 . Other instances of monogenic behaviour in lint quantity are 'no lint' (0-10% ginning) and 'Scant lint' reported in upland cotton.^{3,4} The character 'sparse lint' now assigned the gene symbol li_p is yet

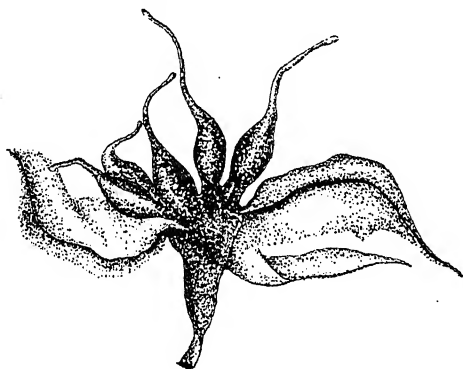
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POLYCARPY IN *CICER ARIETINUM*

In *Cicer arietinum* Linn. polycarpellary flowers were noticed at Kanpur in a local variety 3-1, which is one of the segregates, of a cross between Local Type 1 and N.P. Type 32. It is a tall, erect growing late variety with dark green foliage and possessing large, brown, round and bold seeds. Generally it bears double-flowered pedicels but variations from one to three-flowered pedicels were also noticed.

In most of the double-flowered pedicels the lower flower is the abnormal one. The colour of the flower-stalk remains greenish throughout. The abnormal flower buds appear later than the normal ones and expose their sexual organs very early. The sepals increase in number upto 9 and become petaloid to some extent. The petals also increase in number upto seven and give a shabby appearance to the flowers due to their malformation. Stamens have been noticed to have increased upto 16 in number and present a poly-adelphous con-

dition. Tricarpellary and penta-carpellary apocarpous pistil (Fig. 1) were observed.



The appearance of more than one free carpel in this genus is of interest. It supports the view that the evolution in Rosales has taken place by the reduction in the number of carpels and appearance of Zygomorphy.

More than one carpel are often met with in the sub-family mimosoideæ. Cases have been recorded in the subfamily Cæsalpinioidy-*Poinciana regia* Boj. (Joshi, 1932) and *Saraca indica* Linn. (Krishnamurti, 1931).

Govt. Agricultural College, K. N. KAUL.
Kanpur, M. S. SOLANKI.
August 29, 1949.

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NATURAL HYBRIDS IN ARACHIS NAMBYQUARAE

Arachis nambyquaræ (acclimatized in Bangalore since 1932) has been found to cross freely with the cultivated varieties of *Arachis hypogæa*. Attempts to isolate strains from these crosses of agronomic and commercial importance have not so far been successful.

During 1942, two plants were observed in *Arachis nambyquaræ* plots at the Central Farm at Hebbal, which appear to be natural hybrids. The plants had erect habit; one of them was compact, the other was loose. The pods were prominently veined with a pronounced beak, that of the compact plant bearing 3 seeded pods while the other had only two. The kernels were slightly cylindrical and coloured like *nambyquaræ* with brown interspersed with white bands and streaks. In the latter, in addition to this white splash, a dilute purple wash has been superimposed. This colouration of the testa has not been observed in any

of the various crosses under observation here. The inheritance of this character is under investigation.

Agri. Res. Institute, T. SRINIVASA MURTHY.
Hebbal, K. GOPALA IYENGAR.
December 6, 1949.

FOAM DISEASE OF CITRUS IN ASSAM

TREES of Khasi orange (*Citrus reticulata* Blanco.) older than 5 or 6 years have recently been affected by the malady known in Assam as the "foam" or "weeping" disease. The disease has been noticed only on Khasi orange and not on any other species or varieties of citrus.

Symptoms.—The characteristic symptom is the exudation of white foam or froth from longitudinal cracks in the bark of the trunk at ground upto a foot or a little more above the ground level (Fig. 1). These are commonly



FIG. 1. Foam Disease of Khasi orange. Early stage. Exudation of foam in longitudinal streak shown within inset.

1 to 12 cm. in length and 3 to 10 mm. in width. All branches are affected, but not as frequently as the trunk. The lesions in a single tree vary from one to many. The bark rots, while the wood beneath emits a characteristic disagreeable odour and turns slightly brown. They

are infested by Nitidulid beetles attracted probably by the odour. Microscopical examination shows that the white exuded foam is a mass of yeast cells and mycelia of fungi.

The symptoms start in June with the rains, and continue till September. With the approach of the cold weather, the foam disappears and the lacerated bark peels off exposing the dead wood underneath (Fig. 2).



FIG. 2. foam Disease of Khasi orange. Exposure of dead wood after the peeling off of the diseased bark shown by arrows.

Direct injury results from the gradual increase of the lesions, finally resulting in the complete girdling of the trunk or branch. Through the lesions, insect borers and other destructive agents make their entry while fruit production is lessened and plant life shortened. The disease progresses slowly compared to other citrus diseases, but the damage is no less serious.

Cause.—So far, it has not been possible to determine the cause of the disease. Diseased materials show that species of *Fusarium*, *Phytophthora*, *Botrytis* and *Aspergillus* are common. Infection experiments carried out with pure cultures singly or in combination have so far been inconclusive. It was, however, observed that plants growing on the foot-hills and on ill-drained soils are more susceptible than the others.

Similar outbreaks under the name of 'foam' or 'bark rot' have also been reported from Dutch East Indies by Van der Goot (1928) and Leefmans (1929), from Java by De Vries (1928), from Philippines by Lee (1923) and Morada (1930) and from California by Fawcett (1936). But it has not been possible to identify this malady with any in these countries. Muller, writing from Java, [reported by Fawcett (1936)] suggests that the outbreak in Java was influenced by the extremely dry east monsoon of 1925, just as the outbreak in the Philippines and Southern China was preceded by the drought of 1911. Toxopens [reported by Fawcett (1936)] also writes that in Java the disease occurs especially in the lowland and only in those regions where the trees suffer from drought.

Treatment.—As the disease is a serious one in Assam, experiments were carried out to arrest its virulence. It was found that a coating of Bordeaux paste on the affected bark after scraping checked the further extension of the disease and stopped the exudation of the foam completely. No exudation of foam issues from these lesions subsequently, although new lesions may develop elsewhere in the same trunk or branch.

A detailed report of the extensive investigations in progress will appear in due course.

Mycologist,
Jorhat, Assam,
October 19, 1949.

S. CHOWDHURY.

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WILT OF CASUARINA

A WILT disease of *Casuarina equisetifolia* was recorded from Ganjam by Butler in 1905 and from Mauritius by Shepherd (1928). *Trichosporium vesiculosum* Butl. had been observed on many of the affected trees but its pathogenicity had not been proved. It was considered that it might be a follower of some other root parasite (Anon, 1923).

A similar disease has been observed over a number of years in the casuarina plantations in Nellore, South Arcot, Tanjore and Tinnevely districts. The same fungus was noticed on a number of dead plants. In a few specimens *Diplodia* sp. was isolated from the roots. The

opinion is prevalent among some of the members of the forest and agricultural departments that the casualties among the casuarina plants are more due to either excess of water or lack of it and not due to any definite pathogen.



FIG. 1. Casuarina artificially infected showing black mass of spores beneath the bark.

To determine the role of *Trichosporium vesiculosum* in bringing about the death of casuarina, investigations were commenced towards the end of 1948 at Coimbatore. The Conservator of Forests, Ootacamund, kindly arranged for the supply of sufficient quantity of fresh spores of the fungus from Nellore. These readily germinated and pure cultures of the fungus were obtained from single spores. There was luxuriant growth and sporulation on potato dextrose and oat agars.

The pure culture was utilised for inoculating casuarina trees four to six years old growing

in the pot culture house. The inoculum was placed under the bark near the ground level and bound up with wax cloth. Controls were kept.

Two months later the seat of inoculation had turned slightly brown and a few spores had formed in some of the fissures. Yet there was no symptom of wilt. Six months later the inoculated trees began to wither and in another two months they were completely dead with the bark ruptured and large quantities of the black spore powder were observed under the bark. The formation of spores was evident in some, at the base and in others in the upper portions of the stem. All the six inoculated trees died while all the controls are still healthy.

It is thus established that *Trichosporium vesiculosum* is pathogenic on casuarina and it causes the wilting, drying and ultimate death of the plant. It is a wound parasite and in nature, casuarina bark exhibits rupturing. These may serve as places of entry.

Isolation of diseased patches by trenches has been recommended for arresting the progress of the disease in plantations. The profuse spore formation on dead trees results in air-borne infection. Consequently trenching may not be effective.

Agri. Res. Institute,
Lawley Road P.O.,
Coimbatore,
November 16, 1949.

D. MARUDARAJAN.
T. S. RAMAKRISHNAN.
C. K. SOUMINI.

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NOTE ON *OROBANCHE CERNUA* LOEFL.

Orobancha cernua var. *desertorum* is a common root parasite on tobacco causing a 'near-wilt' appearance of the plant in the field and affecting the yield and the quality of the leaves. This disease was investigated for five years at Guntur and some of the results are here recorded.

In this province *Orobancha cernua* has been found to parasitise a number of host plants, viz., *Datura fastuosa* (purple), *D. fastuosa* var. *alba*, *D. stramonium*, *Lycopersicon esculentum*, *Nicandra physaloides*, *Nicotiana affinis*, *N. glauca*, *N. glutinosa*, *N. rustica*, *N. sandaracæ*, *N. tabacum*, *Petunia* sp., *Physalis minima*, *Solanum melongena*, *S. nigrum*, *S. tuberosum*, *S. xanthocarpum*, *Withania somnifera*, *Helianthus* spp., *Carthamus tinctorius*, *Acalypha indica*, *Euphorbia prostrata*, *Corchorus capsularis*, *C. trilobularis*

and *Cannabis sativa*. Special mention has to be made of *Datura fastuosa* var. *alba* which is easily and heavily parasitized by *Orobanchae*. In one plant the formation of nearly 500 nodules (places of infection) was noticed on the roots. Some other hosts have been found to stimulate the germination of *Orobanchae* seeds without being parasitized themselves. In this category are included *Capsicum annuum*, *Tridax procumbens* and *Bidens pilosa*; 13 to 15% of the seeds germinated close to the roots of these plants but there was no development of any haustorial connection. The behaviour of the parasite towards *Capsicum* deserves special attention. This crop plant can be grown in rotation with tobacco and preceding it in order to reduce the infection from the soil. A large number of the seeds may thus be made to germinate and die out for want of a suitable host.

Garmen (1903) found that the seeds remained viable for 13 years in the soil. The experiments conducted at Guntur have shown, however, that the seeds of *Orobanchae cernua* do not remain viable for over 2½ years either in the soil or when stored in stoppered containers in the laboratory.

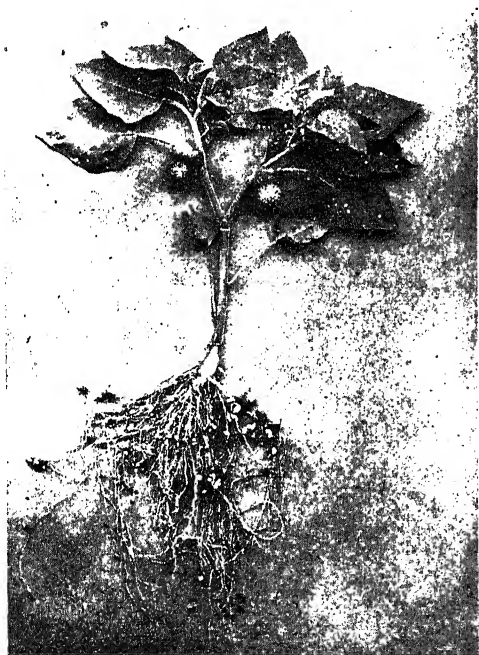


FIG. 1. *Datura fastuosa* var. *alba* infested by *Orobanchae cernua*.

Cattle and goats freely feed on *Orobanchae* shoots. The voids were later collected and applied to soil in pots with tobacco plants. *Orobanchae* shoots developed indicating thereby that

the seeds pass through the alimentary canal without damage and remain viable. The indiscriminate grazing of such animals in the field is thus a source of disseminating the seeds of the parasite.

The seeds soaked in water for one month lose their viability as compared to the dry ones.

A long rotation with tobacco grown once in 3 years and preceded by a chilli crop will save the huge losses due to the ravages of this parasite, especially in Virginian tobacco.

Agri. Research Institute, D. MARUDARAJAN.
Lawley Road P.O.,
Coimbatore,
November 16, 1949.

I. Garmen, H., "The broom rapes," *Kentucky Agri. Expt. Sta. Bull.*, 1903, 105.

A NEW ROOT-ROT DISEASE OF *CYPERUS* SPP.

A root-rot disease of *Cyperus papyrus* Linn., *Cyperus alternifolius* Linn., and *Cyperus eleusinoides* Kunth. was observed at Nagpur during December 1947. The plants affected were all six months old. On culturing, the underground parts of the affected plants yielded *Pythium intermedium* de Bary not so far reported on any species of *Cyperus*.

The disease is indicated by the general paleness of the leaves and stems. The leaves then begin to dry up from tip inwards, extending later to the stem. The underground parts of the affected plants turn dark brown and dry, the mycelium of the organism being found in all the tissues. Sporangia are also sometimes found inside the host tissues, mostly in the cortical cells of the roots.

On rice-meal agar, the isolated organism produces abundant mycelium and sporangia. The hyphae are colourless, highly granular, laterally or dichotomously branched and uniformly thick, measuring 0.6 to 6 μ in width. They are coenocytic when young, but with age become septate. In some cultures a few of the hyphae are found to bear typical finger-like swollen bodies. These bodies may become active and give rise to new hyphae. The sporangia are borne singly or in chains. There are upto 21 sporangia in a single chain. They are spherical or pear-shaped, measuring 6.9 to 21.4 μ in diameter (average 15.5 μ). In the chain, the spherical sporangia are usually separated from each other by cylindrical stalks which are 0.5 to 4.4 μ along and 2.9 to 4 μ across the axis. The sporangia readily germinate in fresh water either by zoospores or by germ-tubes. The

tube of discharge, which swells out into a thin-walled vesicle, is about $5\ \mu$ in length. It appears in all positions, most frequently laterally. The zoospores formed inside the vesicle are reniform and biciliate. The organism may therefore be identified with *Pythium intermedium* de Bary.

Tests for its pathogenicity were carried out on autoclaved soil in pots. The organism proved non-pathogenic on all the three species of *Cyperus* from which it was originally isolated.

My thanks are due to Dr. R. P. Asthana, Mycologist to Government, C.P. & Berar, for the facilities accorded for work.

Agri. Res. Institute, K. A. MAHMUD.
Nagpur,
January 13, 1950.

COLCHICINE INDUCED POLYPLOIDY IN SPINACH

THE results obtained by various workers so far^{1,2,3,4} indicate that the response of crops in terms of fruits or seeds to colchicine treatment is not promising. But it has been found that this treatment leads to increased vegetative growth. The effect of colchicine on Spinach commonly used as a leafy vegetable was tried, and a preliminary report of the results is given here.



Pollen meiosis in the diploid and the tetraploid showing anaphase I ($\times 1500$).

The most successful treatment for the production of polyploids was found to be 0.10% colchicine applied to the growing point for 12 hours. The immediate noticeable effect of the colchicine treatment was a temporary arrest of growth. The first four leaves in the treated plants were thicker and smaller as compared to the control. Later leaves, however, were not as thick nor was there any marked difference in the size except that they were a little broader. The treated plants were characterised by larger stomata, lesser number of stomata per unit area, bigger pollen grains, and lateness in flowering and maturity. There was consi-

derable variability in the size and sterility (15-40%) of the pollen grains of the colchicine treated plants. There were no differences in fruit size and fruit setting of the treated and the untreated plants. Meiosis was studied and the chromosome counts at anaphase I of the diploid and the colchicine treated plants confirmed the diploid number ($2x=12$) and the tetraploid number ($4=24$) as previously reported^{1,3} (Fig. 1).

The stomata, the pollen grain size and the temporary acetocarmine smears of pollen mother cells were used as criteria for the selection of polyploids. A large amount of variability in vegetative and other characters in the colchicine treated population indicates the possibility of selection for an improved type. Further work is in progress.

I am thankful to Dr. J. J. Chinoy, Department of Botany, University of Delhi, for his guidance in the work and helpful suggestions.
Department of Botany, S. L. TANDON.
University of Delhi,
Delhi,
January 3, 1950.

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THE pH TOLERANCE OF AN AQUATIC PLANT COMMUNITY

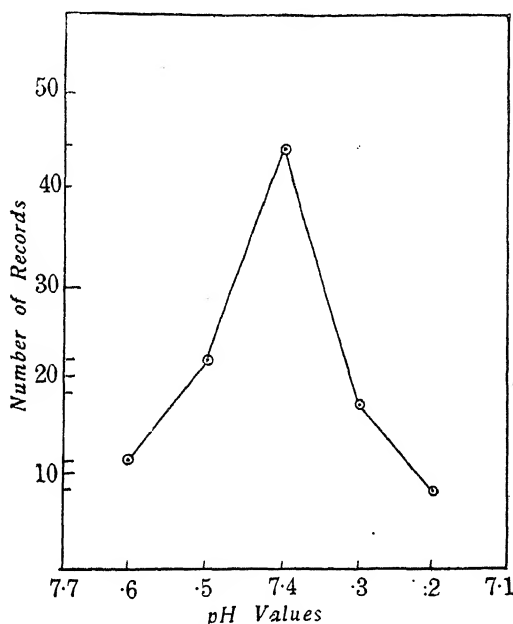
SOIL samples supporting a community of *Hydrilla*, *Vallisneria* and *Potamogeton* from rivers, ponds, and pools at Allahabad, were collected to assess the pH tolerance of this aquatic community.^{1,2,3,4}

The samples were taken at root and the hydrogen-ion concentration was measured by means of B.D.H. Hellige comparator.

The following table gives the various classes of pH values of the soil, the number of records and the percentage number of the total soil samples examined on which the above noted vegetation grows luxuriantly:—

pH classes						
pH values	..	7.2	7.3	7.4	7.5	7.6
No. of records	..	8	18	44	22	11
% of total soil samples		7.8	17.4	42.8	21.4	10.6

The same values are plotted in the following figure:



The graph approximates to normal unimodal variation curve, as pointed out by Pearsall.²

The tolerance of pH values of the community, consisting of *Hydrilla*, *Potamogeton* and *Valisneria*, lies between 7.2-7.6, with the optimum at 7.4. This shows the community's preference for a slightly alkaline soil.

Grateful thanks are due to Prof. S. Ranjan for many suggestions and encouragement.

GIRJA DAYAL SRIVASTAVA.

Botany Department,
University of Allahabad,
January 10, 1950.

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DAMPING-OFF OF CABBAGE, CAULIFLOWER AND KNOLKOH CAUSED BY *PYTHIUM APHANIDER- MATUM* (EDS.) FITZ.

A DAMPING-OFF of cabbage (*Brassica oleracea* L. var. *capitata*), cauliflower (*Brassica oleracea* L. var. *botrytis*) and knolkohl (*Brassica oleracea* L. var. *caulorapa*) was observed at

Nagpur during October, 1948. On culturing the affected seedlings yielded *Pythium aphanidermatum* (Eds.) Fitz. The above species of *Pythium* has not so far been reported on any variety of *Brassica oleracea*.

The first indication of the disease is the yellowish discolouration of the hypocotyl at the ground level. The discoloured part softens and rots and occasionally becomes constricted. The affected seedling ultimately topples over and dries up. The hyphae of the pathogen are present in all the affected tissues. They are chiefly intercellular.

The organisms isolated from the cabbage, cauliflower and knolkohl seedlings were all found to be identical. On rice-meal agar, the organism develops a white dense cottony growth. After six or seven days the whole of this fluffy growth subsides and becomes matted on the surface of the medium. The mycelium is colourless, highly granular, profusely branched and 1.1 to 8.6 μ in width (average 3.2 μ). It is coenocytic at first, but with age becomes septate here and there. In some cultures the mycelium produces typically falcate structures (Fig. 1). The oogonia are terminal, smooth and spherical, measuring 15.2 to 28.5 μ in diameter (average 20.7 μ). The antheridia are terminal or intercalary. They are usually monoclinal and occasionally declinous (Figs. 2 to 4). Usually one, and in rare cases two antheridia are appressed against a single oogonium. They are broadly club or barrel-shaped, measuring 4.4 to 8.3 μ in width (average 6.6 μ) and 6.7 to 13.2 μ in length (average 10.3 μ). The oospores are spherical, smooth and thick-walled, measuring 14.1 to 19.2 μ in diameter (average 15.3 μ). The walls of the oospores are 1.5 to 3 μ in thickness (average 2.1 μ). The sporangia are more numerous in water cultures than in agar media. They are terminal or intercalary, simple or digitately branched lobulate structures, varying in shape and size (Figs. 5 to 8). The rupture of the sporangial wall occurs at the apex or at the tip of one of the side branches, followed by the formation of a thin-walled vesicle. The content of the sporangium flows into the vesicle and becomes segmented into reniform, biciliate zoospores. The zoospores are 9 to 17 by 5.7 to 8 μ in size (average 12 by 7.5 μ).

The pathogenicity of the isolated organism from cabbage, cauliflower and knolkohl was tested on autoclaved soil in pots. The first case of damping-off occurred when the seedlings were 3 days old and the last when they were 17 days old. There was no mortality in any of

the control pots. The organism was reisolated from the affected seedlings. The isolates from

My sincerest thanks are due to Dr. R. P. Asthana, Mycologist to Government, C.P. &

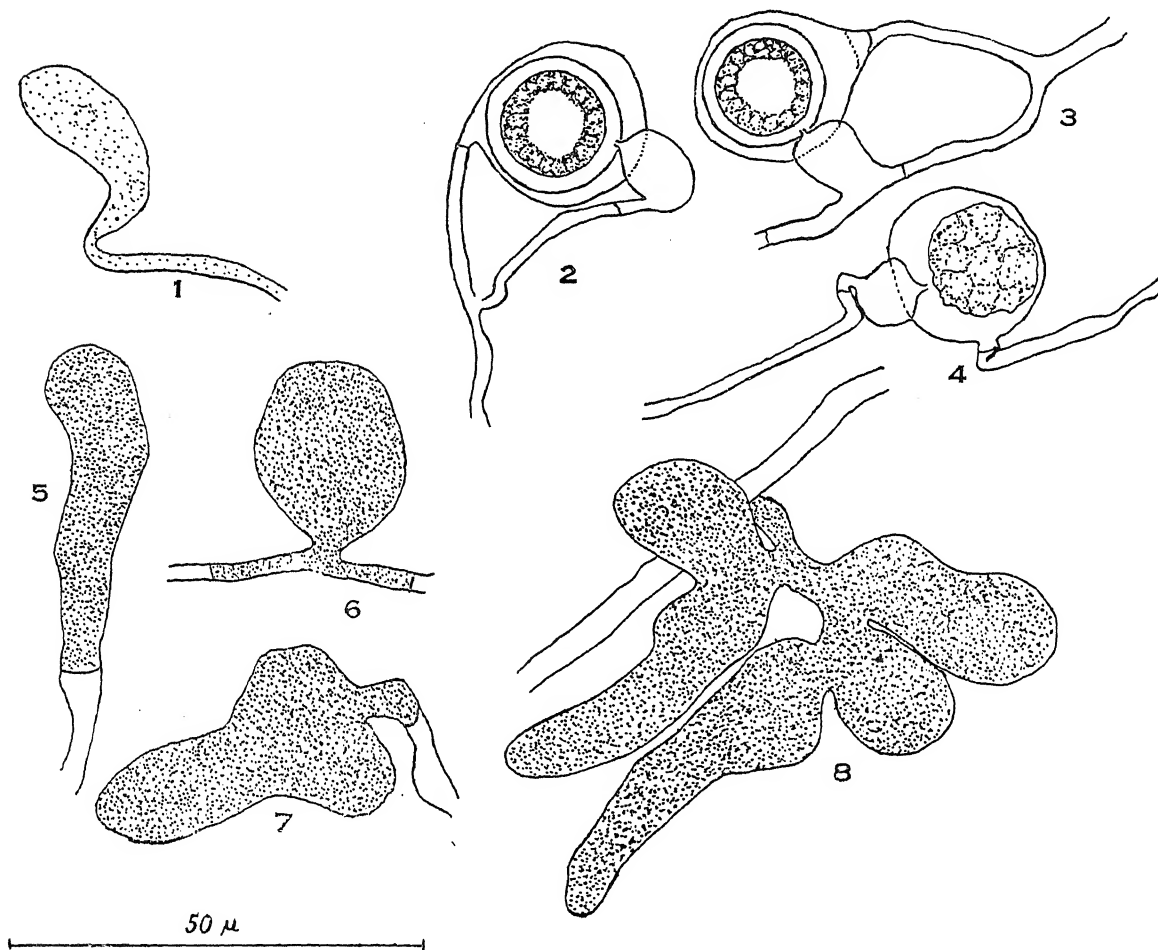


FIG. 1. Falcate structure. FIGS. 2, 3 and 4. Antheridia, oogonia and oospores.

FIGS. 5, 6, 7 and 8. Sporangia.

cabbage, cauliflower and knolkohl were similar Berar, for the facilities accorded for the study. in their pathogenicity to cabbage, cauliflower Agri. Research Institute, K. A. MAHMUD. and knolkohl, being more virulent on cauli- Nagpur, flower than on cabbage or knolkohl. December 17, 1949.

ERRATUM

Curr. Sci., 1950, 19, p. 16, note on "Fluorescent Indicators for Acid-base Titrations," in Table

s. No. 7, read 6.1—8.1 for 3.1—8.1 under pH range.

REVIEWS

Recent Progress in Hormone Research, Vol. IV.

Edited by Gregory Pincus, 1949. (Academic Press Inc., New York, N.Y.), Pp. 529. Price \$8.00.

The Laurentian Hormone Conference held at Franconia, New Hampshire, in September 1948, attracted many eminent investigators in hormone research in U.S.A., Canada and U.K. The outstanding contributions presented therein and the illuminating and critical discussions which followed them are now published as Volume IV of *Recent Progress in Hormone Research*.

The book is divided into four sections and commences with steroid hormone metabolism *in vivo* and *in vitro*. Some aspects of metabolism of estrogen have been emphasised and a critical general survey designed to promote discussion is presented in Chapters 2 and 3. The role of the liver in estrogen metabolism has been discussed in detail and there seems to be general agreement that the inactivation is enzymatic and that it occurs mainly in the liver. Rat liver slices are capable of inactivating α -estradiol but when the ability of liver slices is compared with that of mince prepared from the same liver, it is noted that the liver mince inactivated more variably and to a much lesser extent than did the slices. This suggests that one of the participating enzymes or co-enzymes is unstable in a broken cell preparation and might be enzyme labile.

Progress in our knowledge of the role of hormones in tissue and body metabolism has been very rapid during recent years, and Section II is concerned with anti-hormone problem in endocrine therapy; integration of the effects of adrenal cortical, thyroid and growth hormone in fasting metabolism; alteration in metabolism incident to administration of insulin, adrenalin and thyroid substances studied with the aid of isotopes and the metabolic changes in man following adrenal and pituitary hormone administration. Section III deals with neurohumoral-hypothalamic relationship and the chapters on adrenal function in mental disease; manifestation of altered autonomic and humoral function in psychoneuroses; and the effects of hypothalamic lesion on water and energy metabolism in the rat are very interesting. The role of the hypothalamus in neuro-humoral relationship was not clearly understood

for many years, but with recent progress in experimental technique we are beginning to understand the relationship more clearly. In Section IV, the physiology and function of thyroid are discussed. Dealing with physiologic reactions of thyroid stimulating hormone, Rawson and Money limit their discussion to: (a) factors and conditions which influence the production and release of this hormone by the anterior pituitary, (b) primary action of the hormone, (c) a possible mode of action and (d) factors which influence this hormone action on the thyroid. The chapter on the metabolism of iodine in man as disclosed through the use of radioiodine is of importance. The tracer technique, despite complexities and limitations, possesses advantages which are particularly applicable to studies of human subject, and provides new data of a dynamic nature not accessible by the older methods. Radioiodine has also been widely used in clinical medicine as a diagnostic and therapeutic tool, and Seidlin has summarised the work done in this direction and emphasises clinical application and physiological aspects of this type of therapy.

The volume under review contains a number of articles by scientists engaged in active research in the fields about which they write, and each article is intended to present an authoritative picture of recent progress. Each chapter is well provided with references to original papers. The volume maintains the high standard of its predecessors and is a valuable addition to the bookshelf of every worker in the field of hormones.

N. N. DE.

Elements of Electronics. By G. Windred. (Publishers: Chapman & Hall, Ltd., London), 1949. Pp. 198; 100 figures and 6 plates. Price 15 sh. net.

This book seeks to portray the growth of the science of electronics in all its bearings on various human activities. The treatment is non-mathematical though semi-popular.

The first four chapters of the book give a historical account of the discovery, the methods of production and the conduction in gases of electrons. The properties and general characteristics of photo-electric, photo-conductive and photo-voltaic cells and of thermionic valves are briefly dealt with in the next two chapters.

The seventh chapter describes the performances of the magnetron, the klystron and the cavity resonator in addition to those of the triode as amplifiers and oscillators within the compass of its 24 pages, while the succeeding chapter is devoted to the study of gas-filled valves as power rectifiers.

The X-ray tube and its medical and industrial applications, the cathode-ray tube and its use in the measurement of physical quantities as also in television systems and the role played by the photo-electric cell and the electronic amplifier in the sound film industry are covered in Chapters IX to XII. The principles of electron-optics and their utilisation in the design of the electron microscope and the principles of the cyclotron and the betatron together with their medical and research applications are dealt with in the next two chapters. The book concludes with the fifteenth chapter on "Radio-Location" which attempts an elucidation of the frequency modulated and amplitude modulated pulse methods as applied to the Plan Position Indicator and the Radio Altimeter within 11 pages including 7 figures. An index of a little over 2 pages is added.

In a book that strives to familiarise the reader with the working of such modern devices as the cyclotron or the betatron, it is somewhat strange to find the author fight shy of the word 'neutron' as he does when he describes the nuclei of helium and lithium atoms as containing 2 and 3 protons (p. 34) and stops there. It is perhaps the same conservatism that makes him prefer 4.770×10^{-10} e.s.u. (pp. 31 and 32) as the final corrected value of the electronic charge to the now universally accepted 4.8025×10^{-10} e.s.u. Readers are also apt to be misled by the table on p. 69 which lists the resistivity of selenium in ohms per "cm. cube" and its density also in grams per "cm.-cube". It is better to express in this context, density as gm. per "cubic cm.", even if usage sanctions ohms per "cm. cube" for resistivity though one would prefer ohm. cm. in the interests of accurate terminology.

The few misprints such as 'Kystron' on p. viii, ' V_2 ' for ' V_1 ' on p. 119, line 7, the omission of a connecting line in Fig. 65 on p. 128, etc., would probably not have crept in but for the untimely death of the author during the proof-reading stage.

It is seen from the enumeration of the contents that the work is a masterpiece of condensed treatment of the multitudinous applications of the electronic art. It should exercise its greatest appeal to the educated reader, who

without being a radio physicist, engineer or technician is yet interested in a semi-technical account of the intriguing subject of electronics.

R. L. N.

Faraday's Discovery of Electromagnetic Induction. By Thomas Martin (Edward Arnold & Co., London), 1949. Pp. 160. Price 9 sh. net.

Professor Martin has indeed made admirable use of the material contained in *Faraday's Diary*, and given us a very well-written and thoroughly enjoyable monograph on Faraday's discovery of electromagnetic induction. The monograph, we are sure, would appeal to a much wider class of readers than to students of the history of science, to whom it would of course be especially welcome.

The six chapters comprising the book deal with the subject in the manner of a well-planned series of popular evening lectures, but with a thoroughness and clarity and richness of detail (provided by many diagrams and illustrations from Faraday's own pen) not to be had otherwise. The introductory chapter, the hardest one to write about really, has been very ably done, and makes us see at once that the author of the great discovery was himself no ordinary person; it supplies besides the scientific background against which alone any fair estimate of Faraday's genius can be made. Chapter two deals with the preparation which must necessarily precede every great discovery.

Chapter three gives us a succinct account of the great discovery itself, mostly in Faraday's own words, adding richly to the human interest. Chapters four to six describe some more of Faraday's researches in the field, and are most admirably suited to drive home the lesson that Faraday was far too much of a pure scientist to allow himself to be sidetracked by the enormous practical possibilities of his discovery. As is only well known, the practical applications thereof, of which there are legion today, followed only much later.

This is just the kind of book which, in the opinion of the reviewer, can be prescribed as nondetailed study to every science undergraduate in our Universities. May we also express the hope that many more monographs of this kind, dealing with equally significant discoveries in other branches of science, would soon follow by way of familiarising the younger generation with what is at once beautiful and sublime in the field of scientific research?

Artificial Radioactivity. By P. B. Moon, F.R.S. (Cambridge University Press), 1949. Pp. 109. Cloth Bound, Price: sh. 12/16. Agents: Macmillan.

This book is one of the series of Cambridge monographs on physics the major aim of the series being the presentation of the results on recent research in the entire field of pure physics. It contains 102 pages divided into four chapters. The treatment of natural radioactivity is excluded. With three or four exceptions, such as the very long-lived β -active K^{40} the naturally occurring isotopes of elements below $Z=81$ are all stable, but there are often vacancies among the existing isotopes of any one element. For example Cu^{63} and Cu^{65} are found but not Cu^{64} . This book is concerned with the nuclei that fill such gaps and particularly with their modes of spontaneous transformation. Because these nuclei are unstable and are not replaced in nature by the disintegration of long lived ancestors, they do not exist naturally and must be made from stable nuclei by nuclear reactions. The division of chapters is based according to the three classes of nuclear processes: those in which the nuclear charge Z changes by one unit in either direction, a nuclear proton transforming to a neutron or *vice versa*; those in which the nucleus loses energy without changing its charge; and secondary processes external to the nuclei in question. This is a valuable book. One regrets the method of citation used in the book, namely of quoting the references but omitting the year of publication.

B. DASANNACHARYA.

Investigations of the Band Spectrum of Beryllium Oxide. By Albin Lagerqvist. (Uppsala: Almqvist & Wiksells Boktryckerei AB), 1948. Pp. 98.

This is an inaugural dissertation for the Ph.D. Degree of the Stockholm University and forms a thorough investigation of the rotation structure of the BeO bands. The region from 2000 \AA to 12000 \AA has been investigated with a 21 ft. Wood's grating giving a dispersion of 1.2 \AA per mm. More than 20000 rotation lines belonging to the $\Sigma^*-\Sigma$, and $\Pi-\Sigma$, and $\Sigma^*-\Pi$ systems have been measured and more than half of these have been arranged in series. Perturbations have been located in a large number of bands and are discussed in detail. The name of Prof. Erik Hulthén under whose guidance the work has been carried out is sufficient to indicate the reliability, thoroughness and utility of the investigation. The dissertation

will be a useful addition to the library of any institution teaching physics beyond a degree standard. T. S. S.

The Power and Limits of Science: A Philosophical Study. By E. F. Caldin. (London: Chapman & Hall), 1949. Pp. x + 196. Price 12 sh. 6d. net.

Here we have a timely and much needed study of the scope and limitations of scientific method by a Lecturer in Chemistry who has deeply studied the philosophical implications of the path actually pursued by scientists in wrestling the secrets of Nature. He has analysed the methods followed in Physics and Chemistry and comes to the conclusion that in striving towards quantitative laws Science has developed methods inapplicable to qualitative aspects of life, particularly to our ideas of duty, pleasure, beauty, happiness and so on. He has ably controverted the ideas of eminent authors of popular science like Eddington and Jeans and shows that the regularities observed in Nature are not entirely of our making and that God does not manifest himself as a mathematician. He also points out convincingly that physical principles like Heisenberg's uncertainty principle can have no bearing on questions of predestination and Free Will since the method followed in Science is not designed to study such problems. He also asserts that even the new psychology cannot have any bearing on the problem of human values and trusts that metaphysics and religion will always be the only guides for human behaviour. The arguments for this view are ably set out and are almost convincing.

But the present writer has a lurking feeling that prophesying regarding the future conquests of science is not likely to be a safe guide to our conduct. Just as the idea of colour was not susceptible of quantitative treatment before the advent of the wave theory of light, it might be that many aspects of life which now appear purely qualitative may prove themselves suited to a quantitative treatment. Also psychology, anthropology and comparative religion might profoundly modify what we now take as *a priori* truths in philosophy. In any case the studies of philosophers and scientists have to converge if either can be of service to the other, and students of both will be highly benefited by perusing such a well thought out examination of the scope and limitations of scientific method as is contained in the book before us.

T. S. S.

Practical Spectroscopy. By C. Candler. (Hilger & Watts Ltd., London), 1949. Pp. viii + 190 + 4 Plates. Price 21/- net.

This is a Hilger publication intended to meet the requirements of students of spectroscopy. The nine chapters include measurements of wavelength, qualitative and quantitative spectro-chemical analysis, absorption spectra, infrared spectra, Raman spectra, ultra-violet monochromator, structure of line spectra and interferometers. As indicated by the title the treatment is essentially practical with special reference to Hilger wave-length spectrometer. Each chapter however contains sufficient theory to render the experiments described intelligible. The best chapters are the first three dealing with the setting of the spectrometer and employment of the same for spectro-chemical analysis. Some more details in the methods of procedure seem to be necessary for a beginner at least for the measurement of extinction coefficients and for work, say, on Raman spectra of solids and powders. A special feature is the provision of a number of diagrams illustrating the applications of spectroscopy in various fields of research. In the chapter on Interferometer a conspicuous omission is Michelson's interferometer. The book is a good introduction to the study of practical spectroscopy, and for advanced study or research, the references at the end of each chapter should prove most useful.

M. R. N.

The Soils of Palestine. By A. Reifenberg (Thomas Murby & Co., M/s. George Allen & Unwin Ltd., Ruskin House, 40 Museum St., London W.C. 1). 1947. Pp. 179. Price 16 sh.

For fifteen hundred years, because of erosion, the burning of dung and the destruction of ancient irrigation systems, the land "wherein thou shalt eat bread without scarceness, thou shalt not lack anything of it" has steadily deteriorated. The causes leading to this deterioration and the efforts made by the Jewish immigrant community to restore once again the land to its original fertility so that it may support a big population in happiness and at a high standard of living are discussed in this most readable book. The author who is a lecturer at the Hebrew University of Jerusalem has played no small part in this great task of rehabilitation of the soil.

The book opens with an introduction in which the geology and relief, moisture conditions and climate of Palestine are briefly dealt with. The next chapter deals with soil formation in Palestine, in a detailed manner. The weathering process and particularly the role of colloidal silicic acid in soil

formation are discussed very impressively and the soils that occur in the arid, semi-arid, semi-humid and humid regions of Palestine are described very clearly. The formation of and theories on the evolution of 'Tena Rossa' are discussed and a very fine explanation involving the protective action of humours and colloidal silica on sesquioxide soils is put forward. This delineation leads on logically to the next chapter wherein soil formation under the Mediterranean climate as compared that under other climates, as caused by the influence of the climate and of the parent material the composition of the clay fraction and base exchange and H-ion concentration, is discussed. Under Soils as related to agriculture, the main emphasis is on citrus growing soils and the effect of the composition of the irrigation water and drainage. Very often, this important question of proper drainage is neglected or lost sight of in our country in irrigation projects and the attendant evils of waterlogging and poor yields from land in spite of irrigation is further emphasized by a study of this chapter.

After dealing briefly with manuring of citrus groves and soil erosion caused mainly by indiscriminate grazing and deforestation and wrong management, the great Zionist colonization in Palestine is dealt with and the book ends up with a very interesting description of the Jordan Valley authority. Given time and favourable conditions, the Palestine soils, if managed in the way described by the author, are capable of supporting the large population of the new Jewish State. Important references are given at the end of each chapter. This book will be of great interest not only to the soil scientists but also to all those who are engaged on similar problems of reclamation of deteriorated lands required to settle the many displaced persons and those engaged in improving the agriculture of tropical and sub-tropical areas.

N. G. C.

Vitamin E. By K. E. Mason and 115 others. Editor: Roy Waldo Miner. *Annals of the New York Academy of Sciences*, Vol. 52, Art. 3. (Published by the Academy New York), October 1949. Pp. 63-428. Price 4.50 \$.

Vitamin E is unique in being the only vitamin to have commanded the attention of two international conventions, the one in London in 1939 and the other in New York in 1949. It is a happy coincidence that on the 25th anniversary of the christening of vitamin E by Sure, the New York Academy of Sciences have brought out this valuable monograph embodying the latest advances in the subject. Prior to 1939, information regarding this vitamin was some-

what scanty. The symposium organised by Sir Jack Drummond and Mr. A. L. Bacharach in 1939 under the auspices of the Nutrition Panel of the Society of Chemical Industry helped to crystallise the then existing state of knowledge and indicated the possible lines of further investigations. Between then and now, a vast amount of literature has accumulated, not only regarding the functions and utility of this vitamin but also regarding its inter relationship with other vitamins and hormones in helping to promote the overall picture designated as optimum health. The fact that 116 authors, including names to conjure with in the field of vitamin E, figure in the monograph lends weight to the proceedings. The critical discussion that follows most papers is often extremely helpful in gaining a more intimate knowledge of the subject. The 67 papers contributed to the Conference have been divided into the following five sections: Morphological lesions in vitamin E deficiency; Tocopherols and their esters in enzyme and tissue functions; Protective action of vitamin E in conditions of metabolic stress; Practical nutrition aspects of vitamin E; and vitamin E in clinical medicine. The papers read and discussed reveal the outstanding advances made recently in the field of vitamin E, particularly its role in cellular chemistry in the prevention of auto-oxidation of unsaturated fats, and in clinical medicine. In spite of the many advances in our knowledge, there is, as aptly described by Pappenheimer, "a distressing lack of precise information as to the role of vitamin E in human nutrition".

Research workers in the field of vitamin E will be profoundly grateful to the New York Academy of Sciences not only for sponsoring the Conference on vitamin E but also for this admirable publication embodying the contributions and the discussions that ensued. The inclusion of a Subject and Author Index would have greatly enhanced the usefulness of the publication.

S. RANGANATHAN.

Canning Practice and Control. By Osman Jones. (Chapman & Hall Ltd., London), 1949. Third Edition. Pp. xvi + 322. Price. 36 sh. net.

The third edition of this well-known work makes its appearance some 8 years after its predecessor, with Mr. T. W. Jones as joint author. This interval has witnessed significant developments both in the theory and practice of canning and has therefore necessitated substantial revision in the presentation of the subject matter.

Designed primarily for use by the practical canner, the book presents the reader with a

selected body of factual and theoretical material. The general plan of the work remains as before. The manufacture of tin plate and the causes for corrosion and discoloration are now given in some detail. The analytical and microbiological sections outline revised methods for sampling and examination. Cultural notes on principal food spoilage organisms are augmented and new culture media included. Practically every chapter has a useful, though limited bibliography, and there are many well-titled photographs of plant and equipment together with photomicrographs of certain spoilage organisms, all on art paper inserted at intervals.

The author has achieved a great measure of success in his selection of material which is backed by personal experience and aims to be of direct service to the canner rather than to serve as a treatise. Even attention is given to plant operations as to process controls, but it is more in respect of the latter that the book is of value to the cannery foreman, chemist and manager alike. Probably because a review on the nutritive value of canned foods is a little out of place with the theme of this book, there is evidence of a lack of care in bringing the material here up to date; there are no references to work later than 1936. That canned foods could be more nutritious than fresh foods seems an overstatement, and it is unfortunate that the growing volume of recent work in this field has been ignored; noteworthy among these has been the large-scale survey, begun in 1942, under the joint auspices of the National Canners Association and the Can Manufacturers Institute in the U.S., since published in many technical journals. The methods listed for vitamin assays are neither sufficient nor among the 'newest', and they need therefore to be rewritten in the light of present-day developments in procedure.

There are quite a few errors which, happily, are only minor misprints. The book would undoubtedly recommend itself to the practical canner—for whom it will be invaluable—as well as to everyone interested in the development and practice of the science of canning. It should deserve the success of its previous editions.

A. SREENIVASAN.

Farming for Industry. By R. O Whyte. (Todd Publishnig Group Ltd., London W. 1), 1948. Pp. 160. Price 7 sh. 6d.

This delightfully readable little volume re-presents a successful attempt at presenting a "panoramic picture of farming for industry". As the author himself has confessed the subject matter covered by the book is so wide that each chapter deserves a book in itself. As an intro-

duction to this important subject, however, there are few which can excel this book.

In the course of nine chapters which comprises the volume, the author has entered a strong plea for a more efficient agronomical organisation for the production of technical crops in higher yields and at cheaper costs. In view of the ever-increasing pressure on land, it is imperative that a more intensive cultivation of Farm Crops should be carried out and that the bye-products, now running to waste, should be fully utilised for the production of chemicals and other useful products.

The author has chosen either to ignore or to make only a passing mention of many of the industrial products derived from plantation crops or forest trees. We earnestly hope that the author will soon present his numerous readers a companion volume which would include these equally important products, viz., lac, plantation rubber, tea, coffee, cocoa, essential oil like sandalwood oil, drugs, etc.

A Bibliography of Dyeing and Printing. By L. G. Lawrie. (Chapman & Hall, London), 1949. Pp. 143. 15 sh. net.

The art of dyeing and printing of textiles was no doubt known to the ancient world; but unfortunately, the only records of such knowledge are a few archæological specimens.

The author of the book under review has attempted to present most of the available information on dyeing and printing from the fifteenth century onwards.

In the first part, a complete list of books and pamphlets connected with the tinctorial art has been presented in an alphabetical order of the authors. In all, 816 works are mentioned. In the second part, the same information is presented in chronological order, and in the third, a classified index is given.

It is extremely interesting to note that the rapid increase in the number of books on the subject is closely linked with that period in which the coal tar dyestuff industry rapidly progressed. Since then, the rate of publication of new books appears to have remained approximately the same.

Apart from a few minor misprints such as "dies" for "dyes" on page 137, line 15, the book is well printed and contains a large amount of information relating to the historical development of the art of dyeing and printing. It is felt that the book will be of considerable interest to those engaged in the study and practice of the dyeing and the printing industries.

G. M. NABAR.

The Human Body and its Functions: An Elementary Textbook of Physiology. By C. H. Best and N. B. Taylor. (Revised Edition), 1949. (Chapman & Hall, London.) Pp. xi + 1-500. Price 18 sh. net.

The revised edition of this well-known work, first published in 1932, is practically a new book because it has been largely rewritten and much new material added. Rapid advances have taken place in the field of human physiology during the past two decades and their impact on modern life has created a great deal of popular interest; words like calories, vitamins, deficiency diseases, endocrines etc., appear almost every day in print and there are not many reliable publications which the non-technical reader could consult with advantage. Unlike the *Living Body* by the same authors, addressed to the serious student, this book is intended for the layman; the treatment, language and illustrations are all designed to meet this objective.

The material is arranged in ten parts, beginning with general principles dealt with in the first two chapters, giving an admirably clear exposition of the fundamental principles and the physico-chemical background of physiological studies. The blood and tissue fluids, circulation of blood, physiology of breathing, digestion, nutrition, nervous system, sense organs, endocrine glands, reproduction, sex and heredity are dealt with in the forty-four chapters that follow, covering the usual ground of a course in physiology. The descriptive accounts are lucid and well illustrated with simple drawings (which are independently numbered with reference to each chapter) and a set of eight coloured plates. The emphasis on the physiological aspect has been kept right through the work without bringing in too many anatomical details. The information presented is in most respects up to date taking into account the recent progress in each branch of study. Technical terms are only sparingly introduced into the narrative and adequately explained. Topics of general interest like vitamins and heredity have received special attention. While the general reader will find much information to interest him and satisfy his curiosity, the more specialized reader will discover in the work original methods of treatment in subjects like the working of the internal ear and the conduction of nerve impulses. A most welcome feature is a pronouncing glossary for technical terms. All these should certainly contribute to make this work deservedly popular.

N K P

A Chemistry of Plastics and High Polymers.

By Dr. P. D. Ritchie. (Cleaver-Hume Press Ltd., London), 1949. Pp. viii + 288. Price 25 sh.

All those interested in the rapidly developing field of high polymers will welcome the publication of this book. Dr. Ritchie's book, based primarily on his teaching experience, constitutes a concise but fairly comprehensive, informative and up-to-date discussion of the chemistry of high polymers. It is particularly useful to students and those who want a quick but fair review of the subject.

The first three chapters pertain to the basic concept and kinetics of polymerisation and are followed by a chapter on the chemistry of different polymeric materials. The subsequent three chapters provide a fair discussion of the important polycondensates. The next five chapters are devoted to natural polymers, which is an important feature of the book. A brief mention is also made of the chemistry of drying oils and silicones in the subsequent chapters.

The author has indicated that the book is written primarily for organic chemists but the inclusion of the manufacture, properties and applications of different polymeric materials would have been quite appropriate. The chapter on physical properties besides being limited has a very incoherent discussion. In spite of the limited scope of the book as pointed out by the author, this single chapter should have been elaborated since the significance and clear understanding of the nature of macromolecules is best elucidated by a study of their physical behaviour on which is based most of the present development. The inclusion of references to original literature would have been also useful.

In spite of these shortcomings the book will find immense favour with students and qualified chemists who want to acquaint themselves with the subject. The book is well written and well produced.

S. L. KAPUR.

SCIENCE NOTES AND NEWS

A New Einstein Theory?

In a new edition of his famous work *The Meaning of Relativity*, to be published next month by the Princeton University Press, Einstein will set forth what some of his friends say is the long-sought unified field theory. The scientist himself has given no public hint of any such extraordinary development, but he is said to have told close associates at the Institute for Advanced Study that he regards the new theory as his greatest achievement. He is reported to have given enthusiastic blackboard explanations of his equations, switching from English to German and back again in his excitement, to spellbound groups of his colleagues at recent informal conferences at the Institute.

Einstein's paper explaining his new work will appear as a modest 16-page appendix to his republished book. If it is indeed a statement of a unified field theory, and if it can be confirmed by other workers, it will be the most important event in theoretical physics in many years.

International Meetings on Shellac and Mica

The meetings of the two International Committees on Shellac and Mica of the International Organisation for Standardisation called in New Delhi by the Indian Standards Institution

(ISI) arrived at substantial agreement concerning standards of these commodities on the international plane.

At these meetings, the countries represented included U.S.A., U.K., France, Belgium, Netherlands, Finland, Switzerland, Portugal and India. The International Organisation for Standardisation (ISO) was also represented by Mr. Henry St. Leger, the General Secretary.

The Shellac Committee, which met under the Chairmanship of Sardar Datar Singh, formulated international draft recommendations for standardisation on three commercial varieties of Lac, namely, Seedlac, Shellac and Bleached Lac. Besides specifying the quality standards of the various grades of each product, the international specifications deal with standard methods of test for each physical and chemical characteristic which the various grades are expected to satisfy.

The Mica Committee, which met under the Chairmanship of Shri Chandmull Rajgharia, arrived at substantial agreement on standards concerning grading and classification of Mica. Grading in the Mica trade concerns the sorting of Mica pieces according to their size, while classification implies visual quality determination. All Mica is graded and classified according to methods accepted as standard in different parts of the world. This International Committee has now arrived at unification of these

methods applicable both to grading and classification.

While agreement has been reached on most of the points, a few differences still exist which have been referred to a Working Commission appointed by the International Committee. The Working Commission is expected to report its findings not later than the end of February 1950.

Insect-Proof Packing

The fight against food waste has been carried a stage further in Britain with the development of insect-proof wrappings, as a result of research carried out by the Pest Infestation Laboratory. Just the material needed for the wrappings was found in soft cellulose wadding commonly used for wrapping radio valves and other delicate objects. When several layers of this material impregnated with D.D.T. are used as wrappings, boring insects enter the deadly labyrinth where they wander about, until the insecticide kills them. A further advantage of this wrapping is that it need not be sealed. With food, however, the wrapping is enclosed between sheets of paper to prevent the D.D.T. causing contamination.

U.S. Scholarship for Indian Students

Messrs. Joseph E. Seagram & Sons, Louisville, Kentucky, U.S.A., have offered one scholarship to a student from India in their International Fellowship Programme beginning from September 1, 1950.

The scholarship runs for a period of one year from the date of arrival, during which time the scholar will receive a weekly subsis-

tence allowance of \$52.00. The student must pay for his transport to and from the U.S.A. The age of the candidates should preferably be 30 years or under.

Through this programme young scientists from all parts of the world are given an opportunity to study, observe and do research in the fields of industrial fermentation and distillation, that is, the production of power (ethyl) alcohol. Modern industrial methods, machinery and processes are studied in the Seagram plant at Louisville, Kentucky, under the guidance of competent instructors and research technicians. The applications on the prescribed form should be sent direct to the First Secretary, Embassy of India in the U.S.A., Education Department, 2107, Massachusetts Avenue, Washington, D.C., by March 15, 1950.

Full particulars of the award and copies of the application form have been circulated by the Ministry of Education, Government of India, to Vice-Chancellors of all Universities in India and various technical institutions. Intending candidates may obtain the same from the University or the institution concerned.

Entomological Society of India

Officers and Council for 1950:—President: Dr. H. S. Pruthi; *Vice-Presidents:* Dr. N. C. Chatterjee, Shri M. C. Cherian, Dr. E. S. Narayan, Dr. D. R. Mehta; *Chief Editor:* Shri Y. Ramachandra Rao; *Councillors:* Dr. D. D. Mukherjee, Mr. Ramachandran; *General Secretary:* Dr. S. Pradhan.

FORTHCOMING INTERNATIONAL CONFERENCES

Date	Subject	Organisers	Location
May 1-25, 1950 ..	U.N.E.S.C.O. General Conference (5th Session)	UNESCO	Florence
June 1950 ..	Physics in Chemistry and in Industry	..	Berne
June 29-July 8 ..	High Tension Conference	International Conference on Large Electrical Systems (C.I.G.R.E.) Secretary, British National Committee, C.I.G.R.E., Thorncroft Manor, Dorking Road, Leatherhead Surrey	Paris
July 17-21 ..	16th International Conference of Ophthalmology	Royal College of Surgeons. Secretary, Frank W. Law, 45, Lincoln's Inn, W.C. 2	London
July 17-26 ..	International Meeting for Optical Science	Hon. Sec., Prof. L.C. Martin, Imperial College, Exhibition Road, S. W. 7	London
July 25-28 ..	International Anatomical Congress	Secretary, Miss A. M. Maynall, Dept. of Human Anatomy, Univ. Museum	Oxford

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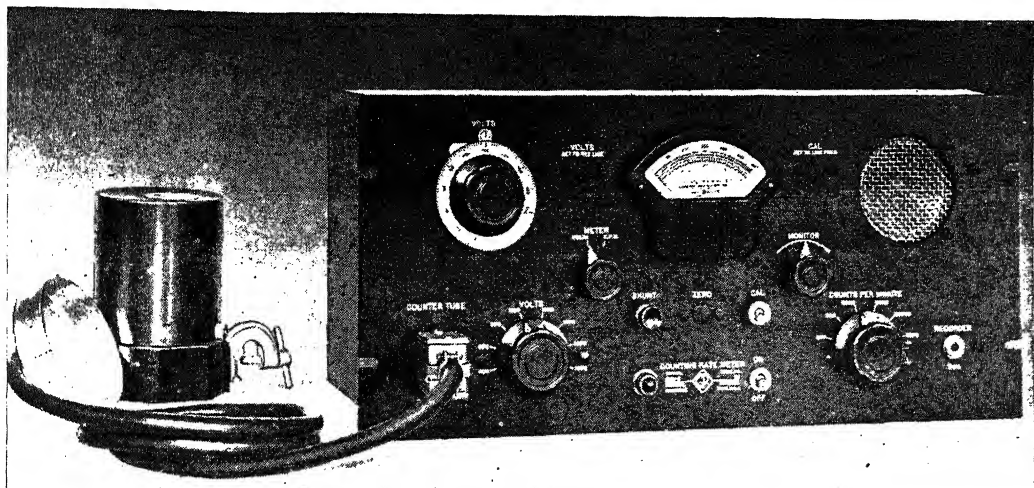
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Duration of Contract: Three years.

Candidates must possess a **first class** post-graduate degree, preferably Doctorate degree in the subject, together with **at least** 12 years' research experience in a well-established research laboratory in India or abroad. They must also be able to organise and develop departments for post-graduate teaching and research in the subject. Previous experience in an University institution will be considered as an additional qualification. For Physics Professorship preference will be given to those possessing working knowledge of French or Persian.

Applications together with copies of necessary testimonials, reprints of published research papers and any other relevant documents in support of the applicant's attainments should be addressed to the Secretary, Ministry of Education (Technical Division), Government of India, New Delhi, so as to reach him not later than the 10th March, 1950.



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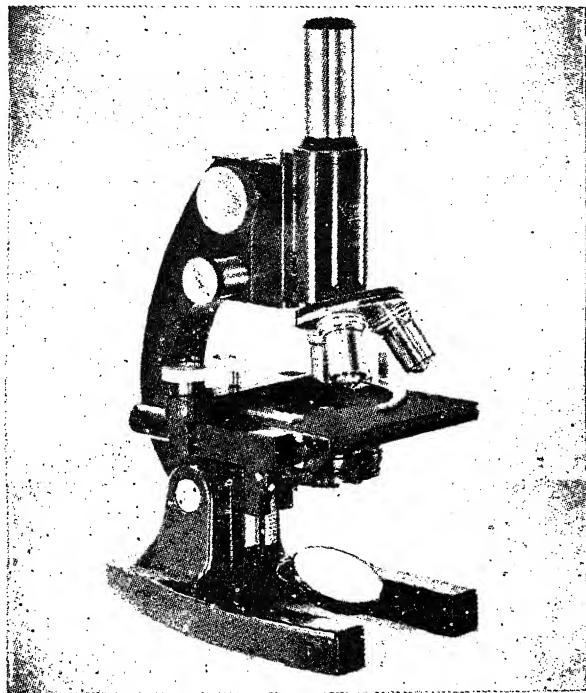
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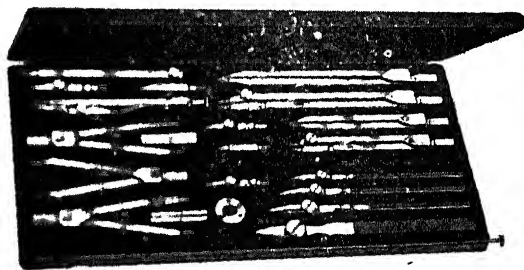
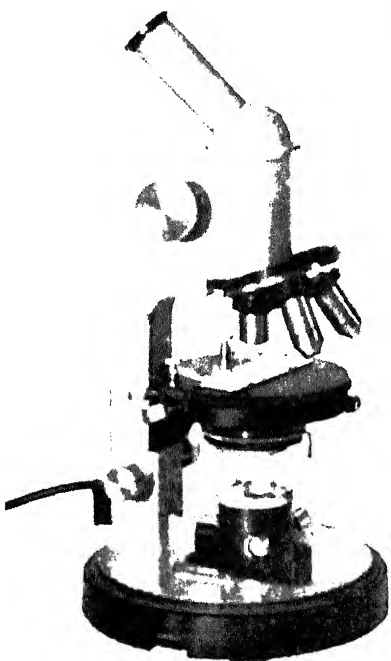
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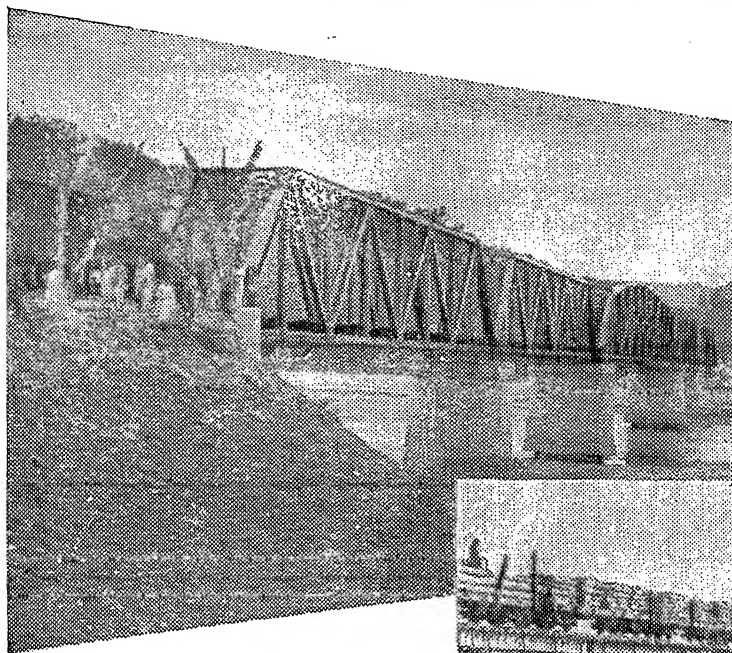
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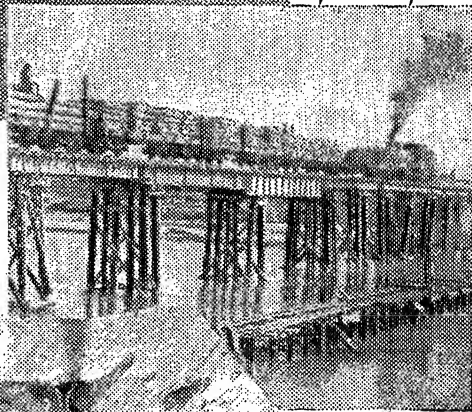
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BIOLOGICAL WARFARE

MR. GEORGE W. MERCK, United States Government Consultant for Biological Warfare, emphasised in his report for 1946 that the possibilities of mass destruction through biological weapons have not been as precisely assessed as in the case of the atomic weapons; also, that unlike the development of atomic energy, the production of these latter can be carried on without much expenditure of money, or construction of large factories, and under the camouflage of legitimate bacteriological research.

That this is by no means an overstatement has been proved by the proceedings of the recent trial of twelve senior Japanese officers, who were accused by the Soviet of carrying on bacteriological warfare against Russia. According to the indictment, a research station with a staff of about 3,000 scientists had been in operation in Manchuria since 1936 for the large

scale production of bubonic plague, typhus anthrax and cholera. Fleas were bred in 4500 incubators, and apparently, an epidemic of plague had been experimentally introduced in Southern China in 1941 and 1942. One of the accused, a Japanese general in the Army, is said to have given full details of the type and design of weapons used for such purposes. These included small sprays fitted with walking sticks and fountain pens, but the main agents were porcelain bombs to be dropped from aircraft. American, Chinese and Russian prisoners of war are reported to have been used in the trials.

The above should open the eyes of everyone that the technical difficulties in the matter of improvising effective international supervision with a view to control are even greater for the biologicals than for the other case.

In this context, the recent statement of

Mr. Trygve Lie, United Nations Secretary-General, is indeed very disquieting. It says, "When the Atomic Energy Commission was created in 1946, the General Assembly entrusted it with the responsibility for working out proposals for the elimination from national armaments not only of atomic weapons, but 'of all other major weapons of mass destruction.' The Commission, however, has never discussed these other weapons, such as biological and chemical poisons. Some of these may be even more destructive of human life than atomic weapons. We do not know by experience what they might do. Unlike the atomic bomb, they were not used in the Second World War, although we know they existed then and have been further developed since. Even a preliminary study of the

problem of establishing international controls for such weapons and providing safeguards against violations might lead to conclusions shedding new light upon what is necessary and attainable in the international control of atomic energy."

Thus, it would seem that even if effective control of atomic weapons could be achieved, there would still be left alternative methods of mass destruction which call for elimination. We feel that herein is a danger whose possibilities must be explored to its roots without any further delay, preferably by an International Commission of Biological Scientists, to whom must be assigned the difficult and responsible task of suggesting, after thorough investigation, ways and means of preventing biological warfare from becoming as serious a threat to civilization as atomic warfare.

BRITISH COMMONWEALTH COLLECTIONS OF MICRO-ORGANISMS

BY decision of the Specialist Conference held in London in 1947,* a British Commonwealth Committee was established to promote the preservation of micro-organisms in collections readily accessible to workers in all parts of the Commonwealth. The initial task was to find out what cultures were being kept in collections, university departments, and other laboratories; when this was completed, attempts would be made to fill the lacunæ revealed.

Questionnaires were sent to laboratories in all parts of the Commonwealth asking for information on the number and types of micro-organisms maintained, and whether these would be made available to other workers. The response to this questionnaire was variable but sufficient progress has been made to justify publication of a Directory of culture collections in the United Kingdom. About 90 collections are named in the first edition of the Directory,

which is to be supplemented by a List of the species maintained by them.

National Committees have been appointed in most of the co-operating countries, and it is anticipated that similar Directories and Lists will be prepared for other parts of the Commonwealth. All workers who have specialised collections, or who maintain cultures for teaching purposes, are asked to co-operate by getting in touch with their National Committee from whom copies of the first edition of the U.K. Directory can be obtained. The Convener of the Indian National Committee is Prof. M. Sreenivasaya, Asst. Professor of Fermentation Technology, Indian Institute of Science, Bangalore 3.

**Report of Proceedings*, published by H. M. S. O. Code No. 47-139. Price 6d. net.

OPPORTUNITIES FOR STUDY ABROAD

About 22,000 fellowships and scholarships, founded by various countries and international organisations and involving a total investment of 100 million dollars per year are available in different countries. Information regarding these is given in "Study Abroad", a Unesco publication which has been recently released.

The publication is the result of a second world-wide enquiry regarding fellowships, scholarships or awards available during the years 1949-50, 1950-51 and 1951-52. The first volume of this publication was published in

1948 as a result of a survey conducted by Unesco in all member States.

Besides listing the various opportunities for study available in different countries, the volume contains extensive surveys of programmes for short teaching abroad and workers exchanges for educational and cultural purposes. It also gives valuable information about some 180 national and international organisations in Europe sponsoring international educational exchanges of young people.

ULTRA-VIOLET RADIATION IN INDUSTRY*

SOME of the many uses of ultra-violet radiation in modern industry formed the subject of a recent demonstration by Hanovia, Ltd., at the company's showrooms in Victoria Street. Broadly speaking, the industrial applications are of two kinds; in one, the ultra-violet radiation is used to produce some specific photo-chemical or physical change, such as, for example, the ageing of paint; in the other, the radiation is used simply as a detecting agency. Numerous examples of both categories, as applied to diverse industries, were exhibited.

One exhibit which will be of considerable interest to mining technologists consisted of a portable battery-operated ultra-violet lamp which can be conveniently carried on prospecting surveys. When irradiated by this lamp minerals, including uranium and scheelite (tungsten ore), fluoresce in characteristic colours. The equipment is particularly useful for detecting the presence of scheelite, which fluoresces only in response to a narrow waveband, including 2537 Å, and this particular wavelength forms about 90 per cent. of the radiation of the new lamp. In its commercial form the lamp is mounted in a light alloy housing, fitted with a carrying handle. A two-way switch operates the ultra-violet lamp as well as a flash-lamp bulb which provides general illumination when required. The equipment is suitable for mains or battery operation, and it is self-contained in a hardwood box the size of an ordinary attaché case.

A different technique is used for the identification of mercury. The mineral specimen is placed in an ultra-violet beam and is heated by a blow-pipe flame. If mercury vapour is given off shadows will be thrown on a fluorescent screen irradiated by the beam, the shadows being caused by the fact that the mercury vapour absorbs the appropriate wavelengths from the beam, which originates from a mercury vapour lamp.

Fluorescence forms the basis of a very simple test which was demonstrated for detecting the presence of aluminium in water. A concentration of 1 part in 10 million can be detected. A similar method can be used for tracing contamination in water supplies. For example, if a cesspool is suspected of leaking through subterranean cracks into a well, this suspicion can be tested by putting a little fluorescent liquid into the cesspool and subsequently irradiating samples of well water under the ultra-violet

lamp. Any fluorescence in the samples proves the source of contamination.

Fluorescence under ultra-violet radiation is used in a very wide range of industries for testing groups of materials and for discriminating between the qualities of similar substances in a particular group.

For example, the shell of a new-laid egg, when exposed to a source of ultra-violet radiation, will fluoresce a delicate rose colour. Stale eggs, on the other hand, will produce a blue or violet fluorescence. Sugars, jams and honey may be similarly tested; in jams, the presence of apple pulp can be shown while turnip pulp, sucrose, molasses and glucose can be disclosed. In brewing, the qualities of barley can be distinguished by their individual fluorescence. The testing of oils and fats, including butter, margarine, lard, cocoa butter and cheese is simplified by fluorescent analysis. In Gorgonzola and Roquefort cheese the living fungi show a brilliant green fluorescence which is absent in dead fungi. In other cheeses the ripening can be followed by use of the ultra-violet lamp, new cheese showing a yellow fluorescence which turns to blue as ripening proceeds.

Ultra-violet lamps are adopted for all types of routine tests in textile production, tanning, paper manufacture, the making of paints and varnishes, rubber industry and so on. In textiles, fibres of all types can be differentiated. There are many ways in which the fluorescence test helps the paper manufacturer. It is possible to distinguish bleached from unbleached pulps, to estimate the nature and amount of loading used and to discover spots and blemishes on finished papers. In the colour and varnish industry the established uses are for distinguishing between gums and phenol-formaldehyde or urea-resins, and for testing the purity of wax and drying oils.

One group of exhibits indicated how the motor industry uses fluorescence analysis to detect the presence of unwanted grease on sheet metal surfaces undergoing preparation for finishing; to distinguish between lubricating oils of different origins and properties, and to trace unwanted mineral oils in brake fluid. Another group of exhibits showed that the uses of ultra-violet in the rubber industry range from the identification and grading of fillers, softeners, vulcanisers, and pigments to the detection of oil on tyre fabric before processing.

Many industries make use of ultra-violet radiation in quite a different way—in the pro-

* By Courtesy of the British Information Services.]

duction of controlled photo-chemical changes. For example, the ultra-violet lamp is commonly used for accelerating fading and ageing processes: to determine the resistance of dyed fabrics, paints and inks to sunlight, and to examine the conditions governing the ageing of rubber, bitumen and similar substances. The exhibits drawn from the automobile industry included a section designed to illustrate ageing and fading tests on safety glass, paint finish and upholstery materials. To illustrate the testing of paints and bitumen finishes photographs were exhibited showing the extensive installations of ultra-violet lamps at the Building Research Station and at the Paints Division

of Imperial Chemical Industries, Ltd. Among these exhibits were samples of magnesium alloy showing the effect of six cycles of weathering test and also showing the protection afforded by temporary corrosion preventatives after twelve similar weathering cycles.

Finally, photo-chemical changes induced by ultra-violet radiation can be used productively in a recently developed process whereby acrylic sheets are cemented in such a way that the joint does not impair the excellent optical properties of the material. In this process cement is applied to the pieces to be jointed; irradiation by ultra-violet light then converts the joint into a solid homogeneous whole.

SEX HORMONES*

PROGRESS in sex hormones has been very rapid, but books reporting it are few. The second edition of the book, *Biological Action of Sex Hormone*, will therefore receive a warm welcome by all those who wish to gain insight into the fundamental aspects of sex hormones. In this volume, the author has included recent rapid developments in the field and has succeeded in presenting a co-ordinated summary of contributions in the field and their practical application.

According to the author the purpose of the book is to survey the present knowledge of sex hormones and to acquaint the readers with the methods employed by the scientists in their research. The book is divided in six parts. The first part which includes Chapters I to IV concerns gonadotrophins of the pituitary and placenta. Discussing the nature and functions of gonadotrophins, the author remarks that its chemical nature has not been exactly determined, but it has been established that the pituitary and placental gonadotrophins are not identical. Evidence of a difference between the gonadotrophins derived from pituitary and placenta is afforded in this chapter. In subsequent chapters the author deals with factors which influence the gonadotrophic activity of the pituitary, factors which influence the reaction of gonads to gonadotrophins and the factors which affect the cytological structure and weight of the anterior lobe of pituitary.

Part II deals with a general view of the gonadal hormones. After a general preview

the author discusses the experimental inquiry into the nature and action of sex hormones. The chemical structure of the three main types of gonadal hormones—oestradiol, testosterone and progesterone—has the same basis and the divergence from the common pattern which account for the diverse actions of these hormones in the body are seemingly slight.

Part III which includes Chapters VI to X relates to androgen, its action on reproductive organs before and after their complete differentiation, the action of androgen on accessory generative organs and on tissue and organs other than these. The first experimental demonstration of hormonal action by testes was made by John Hunter (1794) and later on Brown Séquard (1889) tried testicular extract on himself. The effects were not very striking. Subsequently various other workers carried on investigations on the effects of testicular hormone on different organs and noted the results. With the results obtained by these pioneers to give encouragement, a rapidly growing volume of research has been done and the author has referred to some of these.

Part IV, Chapters XI to XX, is concerned with oestrogens. It gives a brief consideration of the source, metabolism and excretion of oestrogens, gradient of responsiveness, and reversibility of the effects. The action of oestrogens on embryonic gonads and Mullerian and Wolffian system, on the anterior lobe of pituitary and on the gonads after their differentiation, on the accessory genital organs, has been very elaborately discussed. Discussing the factors in the causation of mammary cancer the author quotes that long before the identification of oestrone, the ovary was thought to be an agent

* *Biological Action of Sex Hormones*. By Harold Burrows. Second Edition (Cambridge: At the University Press) 1949. Pp. xiii+615 Price 42 s.

in the development of cancer of the breast. Numerous observations have been made regarding the role of oestrogen in mammary cancer and there is evidence that in women oestrogens are concerned in the etiology of breast cancer. Not only does the clinical evidence point to such conclusion, but now cases are being reported in which cancer of the breast has followed prolonged treatment with oestrogen. The effects of oestrogen on connective tissue, skin, liver, pancreas, blood vessels, thymus and adrenals have also been dealt with in two chapters.

The fifth part surveys the sources, and metabolism of progestins—the active principles of the corpora lutea of the ovary, and their biological action. The main action is on pituitary, on embryonal development, on testes and ovary and accessory genital organs. The progestins play an important part on the oestrous cycle and menstruation. The action of progesterone on the uterus are intimately concerned with reproduction, nidation of ova, pregnancy and parturition. References have also been made to the co-operative and antagonistic effects of oestrogen and progestin and of action common to progestin and adrenal cortical hormone.

The sixth and the concluding section describes the sex hormones of adrenal cortex, pituitary-adrenal relationship, adrenal-gonad relationship and the inactivation of deoxycorticosterone by the liver. Probably the fate of adrenal steroids resembles that of gonadal hormone, but much has yet to be learned about this metabolism.

The international units of sex hormone activity are given in the appendix and are very useful. At the end of the book there is a bibliography which helps the readers to refer to other literature on the subject for additional information.

The author has attempted to cover the entire subject and the treatment is fairly comprehensive and to the point. Emphasis has been laid upon experimental aspects and upon the evidence which these give in support of various theories. The volume is well printed in clear type and is admirably produced. It is educative and commends itself to students of biology and medicine and to all who have academical or professional interest in the subject of sex hormones.

N. N. DE.

INDIAN DAIRY SCIENCE ASSOCIATION

THE Third Annual General Body Meeting of the Indian Dairy Science Association was held on 1st March 1950, at the Indian Dairy Research Institute, Bangalore, Dr. K. C. Sen, Director of Dairy Research, presiding,

This Association, founded in 1947, with the object of furthering the advancement of dairy science, has made noteworthy progress in all directions. One of its most important tasks is the publication of the *Indian Journal of Dairy Science*. A non-technical monthly, *The Indian Dairyman*, is also being published under the joint auspices of this Association and the Bangalore Dairy Cattle Society for disseminating knowledge to the layman.

In their Report, the Secretaries of the Association described the various activities of the Association and appealed to the dairy scientists industrialists and other persons interested in the progress of dairy industry in India to strengthen the Association by enrolling as members and giving liberal donations. Sir Datar Singh was re-elected as President of the Association.

In his Presidential Address (read by the Chairman) Sir Datar Singh pointed out

the need for re-orienting our cattle and dairy development policy keeping in view our present resources, the conditions of milk production and the purchasing power of our people. For increasing milk production we have more and more to depend on the co-operation of the people both in the productive sphere as well as in the marketing side and must organise producers' and consumers' co-operative societies. Considerable advance in this direction has been made in Madras, Bombay, Uttar Pradesh and elsewhere. The Indian Council of Agricultural Research had sponsored the Key Village Scheme for providing approved breeding bulls, giving technical and veterinary aid to the producers, supply of cattle feeds at reasonable rates and castration of all scrub bulls. Reference was also made to the useful role played by Gaushalas and Pinjrapoles in the development of cattle wealth and to the potentialities of the well-organised Military Dairy Farms all over the country. Sir Datar drew particular attention to the practice of adulteration of milk and milk products which must be eliminated quickly if the marketing of milk and milk products is to be organised successfully.

PLANT MICROFOSSILS FROM PALANA LIGNITE EOCENE, BIKANER

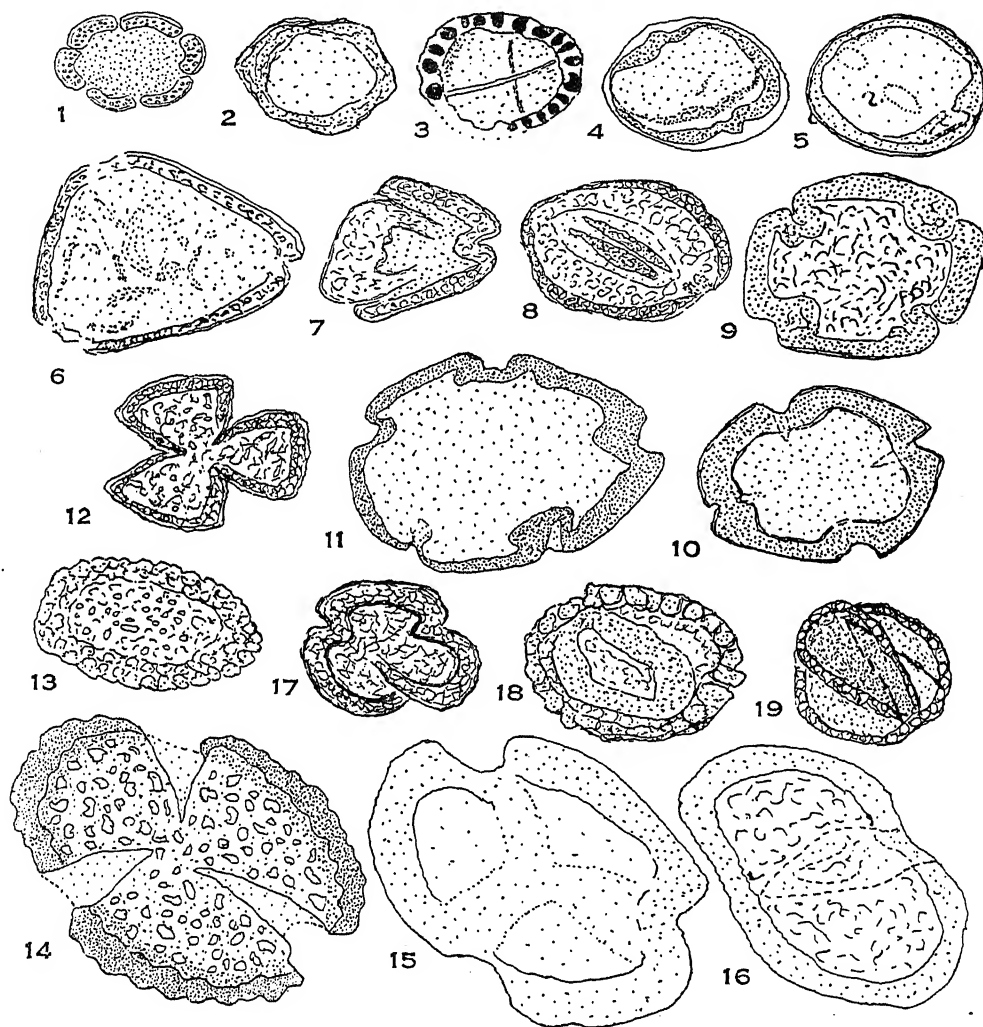
A. R. RAO AND K. P. VIMAL

Botany Department, Lucknow University

SOME samples of lignite from Palana (? Eocene) in Bikaner* on analysis, were found to contain carbonised wood, plant cuticles and other microfossils. Examination of the re-

cently macerated material of this lignite showed at least ten different types of microfossils which are briefly described here.

The microfossils appear to be mostly pollen



1 and 2; type 1, polar and equatorial views respectively. 3; type 2. 4 and 5; type 3, equatorial views at different foci; the clear elliptic areas seen in fig. 5 may be germ pores. 6; type 4, polar view 7-8; oblique polar and equatorial views respectively of the tricolpate type 5. 9-10; polar views at two different foci of the tetracolpate type 6. 11; a pentacolpate grain belonging to the same type. 12; polar view of the tricolpate type 7. 13; type 8. 14-15; polar views at different foci of the tricolpate type 9. 16; equatorial view of the same. 17-19; type 10. 17; polar view. 18; equatorial view with two flanges in focus, 19; with only one flange in focus. All figures magnified 675 times.

* Collected in 1948, by Mr. S. S. Misra, M.Sc., and kindly placed at our disposal by Prof. S. R. Narayana Rao.

grains, with no trace of pteridophytic spores with triridiate marks. Types 5, 7, 9 and 10 appear to be tricolpate in form; Type 6 is generally tetra-

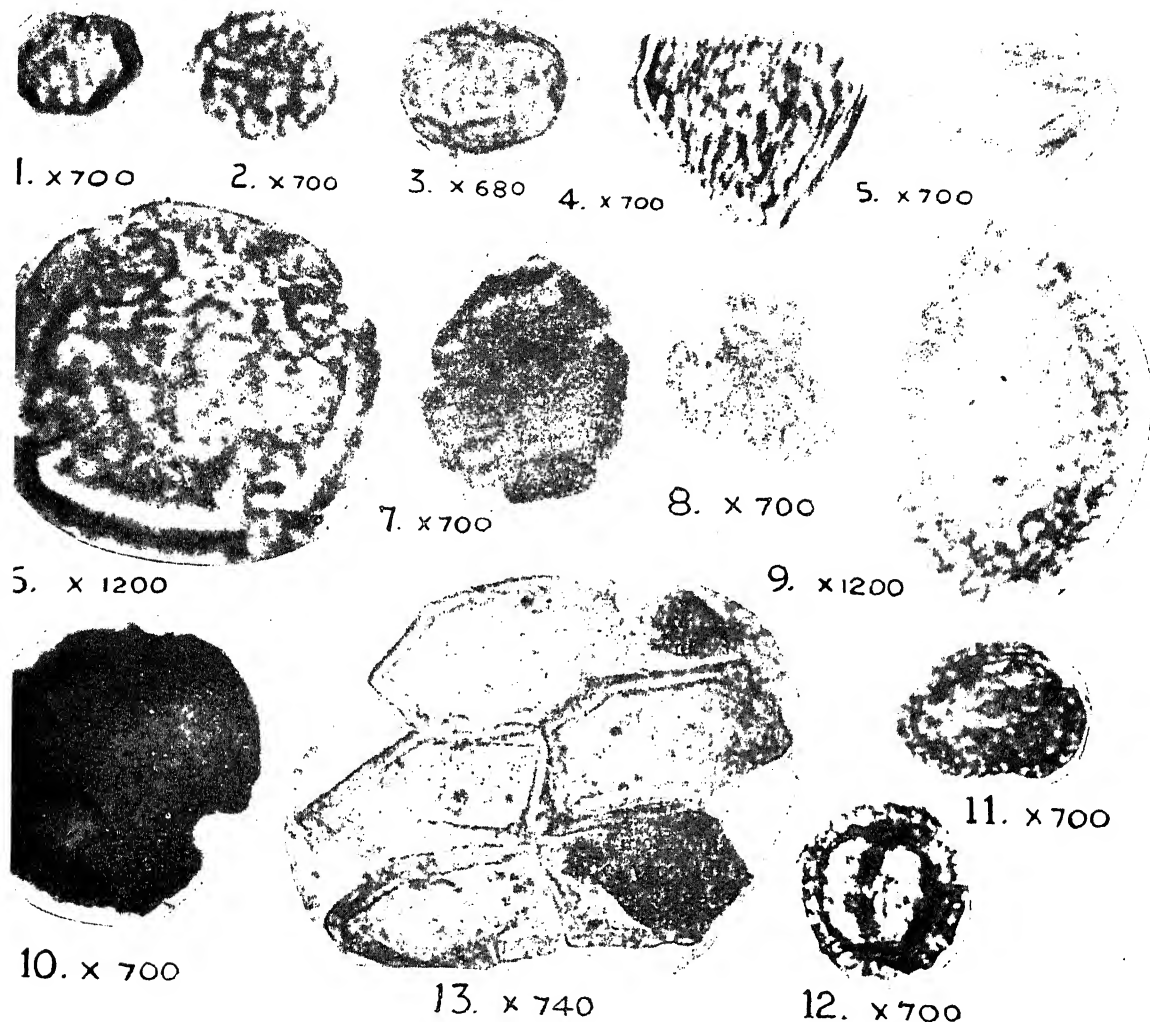
lpate and probably pentacolpate also. Type appears to be hexacolpate, but its structure is obscure. Types 9 and 10 correspond to a brachytrilistrium type of Naumova.¹ Type without any pores or furrows can be classed under Aporina of the same author. The structure of type 2 could not be clearly made out.

DESCRIPTION

Type 1 (Fig. 1-2, Photo. 1).—Polar view oblique (Fig. 1 and Photo. 1), $20.8\mu \times 22.4\mu$,

two poles likely thicker. In the equatorial view can be seen six thin slits corresponding to the five gaps in the exine seen in the polar view. These are not shown in the figure; they may be the germinal pores or furrows. Light yellow in colour.

Type 2 (Fig. 3 and Photo. 2).—Equatorial view almost rotundate, $24.0\mu \times 24.0\mu$ (Fig. 3 and Photo. 2), exine thick, surface negatively reticulate, germ pores not clear. Two thin slits,



1—Polar view of type 1. 2—Equatorial view of type 2. 3—Probably equatorial view of type 3. 4—Equatorial view of type 4. 5—Oblique polar view of type 5. 6—Polar view of tetracolpate type 6. 7—Polar view of pentacolpate grain of same type. 8—Equatorial view of type 7. 9. Probably polar view of type 8. 10—Oblique polar view of the tricolpate type 9. 11—Polar view. 12—Equatorial view of type 10. 13—Surface view of cuticle. x lobed, exine thick with thin hyaline cuticle-like outside layer, inner layer $2\frac{1}{2}$ times as broad, annular, surface smooth; equatorial view (Fig. 2) broadly elliptic, $24.0\mu \times 12.8\mu$, with the

one equatorial and the other vertical but a little to the right of the median line, are seen (Fig. 3). Light brown in colour.

Type 3 (Figs. 4, 5 and Photo. 3).—Probably

equatorial view, oval $20.8\mu \times 32.0\mu$ (Fig. 4), exine thick with a thin cutin-like layer, exine further thickened at the poles, surface smooth; (Fig. 5) oval, the three oval translucent areas which appear along the equatorial line at a different focus, may be the germ pores. Brown in colour.

Type 4 (Fig. 6 and Photo. 4).—Equatorial view triangular, $44.8\mu \times 38.4\mu$, exine thick, granular with thin cuticle, pores three, one at each angle. Yellow in colour.

Type 5 (Figs. 7-8 and Photo. 5).—Tricolpate. Oblique polar view (Fig. 7) $28.8\mu \times 32.0\mu$; equatorial view (Fig. 8) $35.2\mu \times 30.4\mu$, the two median thickenings in Fig. 8 are perhaps the two ridges of the wall which are seen in the polar view. Exine thick, surface uneven, negatively reticulate. Brown in colour. The grain resembles in appearance but not in size the pollen grain of *Cornus amomum*.

Type 6 (Figs. 9-10 and Photo. 6).—Tetracolpate. Polar view (Fig. 9), $38.4\mu \times 43.2\mu$, colpæ diagonally placed, walls folded inwards, germinal slits thin and narrow along the colpæ (Fig. 10), exine thick, surface smooth. Brown in colour. A pentacolpate grain whose oblique polar view is seen in Fig. 11 and Photo. 7, belongs perhaps to the same type although there is some difference in size. The grain resembles in appearance and to a certain extent in size also, the pollen of *Tilia americana*.³

Type 7 (Fig. 12 and Photo. 8).—Tricolpate. Polar view (Fig. 12), $35.5\mu \times 33.6\mu$, three lobed, clefts deep, exine thick, granular surface reticulate and sculptured. Light brown in colour.

Type 8 (Fig. 13 and Photo. 9).—Probably

equatorial view, elliptic, $25.6\mu \times 44.8\mu$, no furrow or germ pore seen. Photo. 9 shows the surface of the grain covered by dome-shaped structures which are responsible for the scrobiculate sculpture of the exine. A comparison in appearance but not in size, can be made with the pollen grains of *Potamogeton natans*.⁴ Wall dark brown in colour, body lighter.

Type 9 (Figs. 14, 15, 16 and Photo 10).—Tricolpate, brachitrilestrum type. Oblique polar views (Figs. 14 and 15) at the higher and lower foci respectively, $57.6\mu \times 56.0\mu$, three flanged, flanges cleft upto the middle of the grain exine thick with reticulate thickenings. Equatorial view (Fig. 16), $56.0\mu \times 38.4\mu$. Dark brown in colour.

Type 10 (Figs. 17, 18, 19 and Photos. 11-12).—Tricolpate, brachitrilestrum type, polar view (Fig. 17 and Photo. 11), $28.8\mu \times 33.6\mu$, exine thick, surface with reticulate thickenings; equatorial view with the two flanges in focus (Fig. 18 and Photo. 12) $33.6\mu \times 32.0\mu$; oblique equatorial view with one flange in focus (Fig. 19 $28.0\mu \times 27.2\mu$) Light brown in colour.

Cuticle (Photo. 13) with epidermal cells measuring about $44.8\mu \times 24.0\mu$, average thickness of wall 4.0μ . Yellow in colour.

This investigation has been carried on with the help of a grant awarded by the Scientific Research Committee of the U.P. Government.

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1. Naumova, S. N., "Spores and pollen of the coals of U.S.S.R.," *Rep. XVII, International Geological Congress*, 1, 353-64.
 2. Erdtman, G., *An Introduction to Pollen Analysis*, 1943, 85, fig. 143.
 - 3.—, G., *Loc. cit.*, 123, fig. 359.
 4. Wodehouse, R. P., *Pollen Grains*, 1935, 221, fig. 8.

IRREGULAR SEGREGATIONS IN YEAST HYBRIDS

BALAJI D. MUNDKUR

DEVIATIONS in tetrad segregation from the 2:2 Mendelian expectation in heterozygous *Saccharomyces* hybrids have recently been attributed (Winge and Roberts¹) to a degeneration of four nuclei from an initially 8-nucleate complement. A chance survival of any four nuclei from among the gametic products of two successive mitoses (following a reduction of the hybrid nucleus) has been considered an explanation for 2:2, 3:1, 1:3, 4:0 and 0:4 ascus types. This view is based on their analysis of four 5- and 6-spored heterozygous asci genetically marked for one character only—the fermentation of maltose—and is adopted as an alternative explanation to that held by Winkler², Lindegren³, and Mundkur⁴.

The following considerations, based on data presented earlier, will indicate the inadequacy of employing a single genetical marker in investigating non-Mendelian inheritance.

1. Five different crosses involving from five to ten genetical markers (Mundkur⁴) yielded asci in which segregations of loci determining the fermentation of various sugars and the syntheses of a purine and some B vitamins were markedly disturbed. In spite of the extensive non-Mendelian ratios for such markers, segregations of mating type specificity (*a* and *a* segregants) conformed to the expected 2:2 Mendelian ratio in all but three of twenty-four 4-spored asci. Clones from the three exceptional asci mated with neither *a* nor *a* standard

testers. No irregularities of mating type segregation were discernible in ten other 3-spored asci. Mating reactions of each segregant from these thirty-four asci were tested against both *a* and *α* standard haplophase clones. This behaviour is not consistent with the explanation advanced by Winge and Roberts since the *a/a* alleles would not be exempted from irregularities on their hypothesis.

2. Mundkur⁴ found that among these same asci the adenine independent white haplophase parents AD* (W) when crossed to adenine deficient, pink haplophase parents *ad*(P) yielded tetrads of the constitutions AD(W) AD(W) AD(W) AD(W); AD(W) AD(W) *ad*(W) *ad*(W); *ad*(W) *ad*(W) *ad*(W) AD(W); and *ad*(P) *ad*(P) AD(W) AD(W). It had been demonstrated previously⁵ that the pink clones are generally associated with adenine dependence.

3. Meiosis is completed in two successive divisions. No matter how many genes may be involved, a single reduction division can produce a maximum of four different genotypes and no more. Subsequent divisions of the nuclei derived from the tetrad do not increase the variety of genotypes. This fact has been amply confirmed by analyses of 8-spored asci of *Neurospora*. More than four kinds of clones from a single 8-spored ascus have never been reported, no matter how many genes have been heterozygous in the hybrid. A hybrid heterozygous for two pairs of genes can produce only four kinds of progeny. One heterozygous for three or more pairs is potentially capable of producing 8 or more genotypes. On Mendelian theory, however, each single tetrad can produce only 4 kinds of clones, irrespective of the heterozygosity of the hybrid. Winge and Roberts' explanation of irregular segregations is automatically excluded since it can be shown to require more than 4 genotypes in a single tetrad. For example, the tetrad listed below (Lindegren³, page 25-2) produced three pink cultures and one white culture:

5919 *a G IN PN PY s TH* AD(W)
5920 *a g in pn py S th* *ad*(P)
5921 *a g IN pn PY s TH* *ad*(P)
5922 *a G in PN Py S th* *ad*(P)

The three pink cultures are genetically different at two loci, e.g., *g in*, *g IN*, *G in*. The white culture is different from the three pinks being, *G IN*. If eight nuclei had been produced and four had died, it would be necessary to account for one absent pink and three absent white clones without increasing the variety of genotypes beyond the maximum, namely, four. Inspection reveals that this cannot be done. For example, if culture *G IN* were white it

would not increase the variety of genotypes, but two more white cultures must be accounted for. If the *g in* culture were white, the reduction would have produced five kinds of segregants and if the *g IN* culture were white, six kinds of clones would have resulted from the reduction: *G IN* (White), *g in* (Pink), *g in* (White), *g IN* (Pink), *g IN* (White), *G in* (Pink). The italics designate clones grown from the ascus; the roman letters indicate clones required by Winge and Roberts' hypothesis.

4. Mundkur⁴ reported a mating (CIA × 3349) which yielded a tetrad of the following constitution. It is discussed as an example; many similar tetrads were found. (The cross was heterozygous for all the markers used).

M532 *a G ME MG MA ad*(W) *pn in*
M533 *a G ME MG m₁ ad*(W) *pn in*
M534 *a g ME MG MA AD*(W) *PN IN*
M535 *a g me MG MA AD*(W) *PN IN*

On the basis of Winge and Roberts' view, each of the ascospores would necessarily have an identical twin, since each one is different and the maximum of four genotypes has been attained. This would, however, mean a 6:2 ratio for *ME/me*, an 8:0 ratio for *MG/m₁*, and a 6:2 ratio for *MA/ma*, since the hybrid was heterozygous for these loci. In addition, the anomalous *ad*(W) appeared in this ascus.

This analysis proves that the origin of non-Mendelian, mature 4-spored asci is not amenable to Winge and Roberts' view that a random destruction of four nuclei occurs in an initially Mendelian, 8-nucleate complement. It is evident, moreover, that use of one marker alone in evaluating irregular segregations is deceptive, and that the greater the number of diagnostic genetical markers employed the easier it is to detect inadequacies in the interpretation advanced by Winge and Roberts.

I am indebted to Dr. Carl C. Lindgren for help in the preparation of this note.

1. Winge, O., and Roberts, C., *Nature*, 1939, **165**, 157. 2. Winkler, H., *Die Konversion, der Gmr. Jena.*, 1930. 3. Lindgren, C. C., *The Yeast Cell. Educational Publishers, Inc., St. Louis*, 1949. 4. Mundkur, B. D., *Ann. Missouri bot. Gard.*, 1949, **36**, 259. 5. Lindgren, C. C., and Lindgren, G., *Proc. Nat. Acad. Sci., (US)* 1947 **33**, 314.

* Abbreviations:

G/g, *ME/me*, *MG/m₁*, *MA/m₁* and *S/s* indicate galactose, melibiose, alpha methyl glucoside, maltose, and sucrose fermentations, respectively. *AD/ad*, *PY/py*, *TH/th*, *PN/pn*, and *IN/in* indicate abilities (or inabilities) to synthesize adenine, pyridoxine, thiamin, pantothenate and inositol, respectively. P and W indicate pink and white clones.

WHY STATISTICS*

FLUCTUATIONS are the fundamental feature of all measurements, whether they relate to the physical, biological or social sciences. But all contingent knowledge is based on measurements and observations which are subject to such variation. Each measurement or observation is only one of many possible similar sets, and hence there arise the statistical concept of a random sample from the totality of all such samples, i.e., the universe. These random samples enable one to draw valid conclusions about the universes from which they are drawn, with the aid of the calculus of probability. Such knowledge as is based on random samples is necessarily incomplete, and conclusions drawn therefrom, although valid, are uncertain. But it is possible to estimate the valid measure of the degree of uncertainty with the help of the calculus of probability. Thus we have the following paradox:

If statistical theory is right, predictions must sometimes come out wrong; on the other hand, if predictions are always right, then statistical theory must be wrong.

This statistical or uncertain inference is in sharp contrast to deductive or absolutely certain conclusions. Pure mathematics is an example of such deductive logic. The certain inferences of deductive or deterministic views which once dominated the physical sciences have gradually given place to probabilistic-statistical inferences. All scientific knowledge being based upon evidences which are formally incomplete is only probable but never absolutely certain. Predictions based upon scientific knowledge must prove to be fallible or uncertain to an anticipated extent. But pure mathematics being fundamentally deductive in nature does not itself belong to the field of science.

The scope and range of the statistical method become larger and larger as they include within their domain the concepts of classical physics,

the kinetic theory of gases, statistical mechanics and thermo-dynamics, biometry and so on, successively. At each successive stage, the importance of the fluctuations of variations in the phenomena become more and more marked and the statistical methods used for the study of these phenomena, more and more pronounced. Especially so is the case where more than one factor and their combinations have to be studied at one and the same time. Here the classical method of isolating and studying one factor at a time completely fails. It is only the statistical method of design of experiments and analysis of variance that can help us. In the industrial field also, where variations do exist, the statistical methods of quality control have enabled one to maintain the quality of manufactured products at a desired level. Statistical sampling is the most adaptable, rapid, economical and, in the true sense, scientific method of factual ascertainment in place of the traditional method of exhaustive census or attempted complete count. In certain cases where factors of variation are neither amenable to control nor to experimentation, the only approach possible is the statistical one. Thus statistics has supplied science with a general method for inductive inference and it has found growing practical applications in the affairs of everyday life. Statistics is essentially an applied science and in statistical research the greatest stimulus has always come from the need of solving practical problems.

Sample surveys with respect to crops are an instance in point. The advantages of such surveys over the older methods of complete-enumeration are greater speed, economy and precision. The governments not only in India but also elsewhere and the U.N.O. have now been increasingly aware of the importance and usefulness of such sample surveys.

In India, the present great urge for solving the vital national problems is giving real strength to the progress of statistics, and statistics, no doubt will play an important part in solving these problems.

M. C. SATYANARAYANA.

* Abstract of the Presidential Address of Prof. P. C. Mahalanobis, F.R.S., General President, at the 37th Session of the Indian Science Congress, Poona, 1950.

DR. S. CHANDRASEKHAR

The Adams Prize, offered by the University of Cambridge, for an essay on a mathematical, astronomical, or natural philosophical subject, has been awarded this year, equally to

Dr. S. Chandrasekhar, Chicago, Dr. J. C. Burkill, Cambridge, H. W. Hayman, Exeter, and Prof. J. M. Whittaker, Liverpool.

LETTERS TO THE EDITOR

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A NOTE ON THE COMPRESSIBILITY, VISCOSITY AND SURFACE TENSION OF AQUEOUS SOLUTIONS OF ALKALI HALIDES

USING Debye-Sears¹ arrangement for the diffraction of light by ultrasonics, the ultrasonic velocity v , and hence the adiabatic compressibility β have been determined from the relation

$$\beta = \frac{1}{v^2 \rho} \quad (\text{where } \rho \text{ is the density determined}$$

by a sensitive Bunge balance) at different molar concentrations for the four alkali halides KI, KBr, KF, and NaF, as also their viscosity (η) and the surface tension (T) at the same temperature and atmospheric pressure. The values of v , β , η , T and ρ , at different concentrations, show two interesting empirical relations (1) between η and β , and (2) between v , T and ρ ,

viz., (1) $\eta = 2.0 \times 10^2 \beta$, so that $\frac{\eta}{\beta}$ is a constant, for all the four halides, independent of temperature and concentration. (η is expressed in 10^{-3} dynes/sq. cm./unit velocity gradient, and β is expressed in 10^{-6} c.c./c.c./atm.) (2) $T = 1.2 \times 10^{-6} \rho v^{3/2}$ so that $\frac{T}{\rho v^{3/2}}$ is a constant, 1.2×10^{-6} ,

for all the four halides, independent of temperature and concentration.

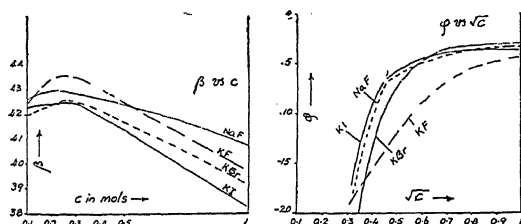
Fuller details will be published elsewhere. Andhra University, B. H. KRISHNAMURTY, Waltair, January 28, 1950.

1. Debye and Sears, *Proc. Nat. Acad. Sci. Wash.*, 1932, 18, 410.

A NOTE ON THE ADIABATIC AND APPARENT MOLAR COMPRESSIBILITIES OF ALKALI HALIDES

BACHEM¹ found that the adiabatic compressibility β of aqueous solutions of electrolytes conformed to the relation $\beta = \beta_0 + Ac + Bc^{3/2}$, where β is the adiabatic compressibility at the molar concentration c and β_0 is that of water while A and B are constants, A being large and negative, and B small and positive. According to this equation therefore, β should fall off progressively with increasing concentration. Similarly, the apparent molar compressibility ϕ_c of electrolytes at concentration c (which is a function of β), was found to be negative, and follow the linear relation, $\phi_c = a + b/c$, where a and b are constants (Gucker²).

In the present investigation the adiabatic compressibility β , and hence the apparent molar compressibility ϕ have been determined by the ultrasonic method, using the Debye-Sears³ arrangement for the diffraction of light by ultrasonics, for the four alkali halides KI, KBr, KF, and NaF, in the lower concentration ranges. The curves indicate the relation between β and c and ϕ and \sqrt{c} .



The adiabatic compressibility in every case shows a maximum at a concentration of nearly 0.3 mol., proving that for this range, Bachem's formula does not hold.

Again, the relation between ϕ and \sqrt{c} , for all the four halides is not linear as one would expect, thus departing from the Gucker's formula. ϕ is of course negative, as required by theory, but increases rapidly upto a concentration of 0.3 mol. and then rises rather slowly in all the four cases. Thus both the adiabatic and apparent molar compressibilities of these halides show departures from their expected types of behaviour with concentration, at the lower concentration ranges.

A fuller account of this work and a collective study of v , the ultrasonic velocity, β , ϕ , η , the viscosity and T , surface tension will be published elsewhere.

Andhra University, BH. KRISHNAMURTY.
Waltair,
January 28, 1950.

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ON CARBONACEOUS DISCS AND 'ALGAL DUST' FROM THE VINDHYANS PRE-CAMBRIAN

ATTENTION has been drawn previously by Misra¹ to the occurrence of (1) glauconite grains which are believed to be casts of organisms and (2) on alga (*Dasycladacea*) in the Vindhyan limestones. Further work has revealed two additional forms indicative of organic

life. These are (1) Carbonaceous disc-like bodies, (2) algal dust.

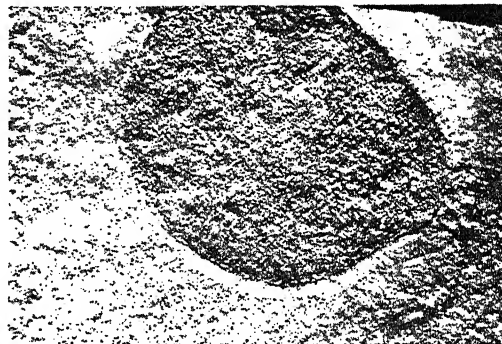


FIG. 1. Carbonaceous disc in Rohtas Limestone².
Loc.— Banjari, Shahabad District, Bihar.

1. *Carbonaceous disc-like bodies*.—The Banjari Carbonaceous Rohtas Limestones, which show thin lenticles of bright coaly matter, have yielded black (carbonaceous) disc like bodies, having a diameter of 26 mm. on the average. The margin of the discs is marked by a prominent raised border, and the surface is covered with bright black granular coaly matter. A transfer preparation made from a disc shows structureless carbonaceous shreds, similar to those seen in the thin sections of coaly lenticles of the limestones. Similar carbonaceous discs but of smaller size (maximum 7 mm.) were discovered by Jones² from the Suket shales at Neemuch late described as primitive Brachiopods by Chapman.³ Walcott and Resser⁴ had suggested that the bodies represent true fossils and definitely brachiopods, which agreed most closely with forms of *Acrothele* from the Cambrian. The collection was finally studied by Sahni⁵ who remarks, "finally, as Mr. Chapman has shown, these fossils are now completely carbonised, and although cases are known of chitinous fossils becoming carbonised, yet it is only an assumption that the present fossils were originally chitinous. However, in my opinion, it is not the carbonised character of the surface which is the real obstacle to regarding these discoidal bodies as brachiopods, but the lack of any features which may be definitely attributable to members of that class". Howell,⁶ however, is more in favour of their being plant remains since when heated the shiny film of the fossil glowed and burnt to grey ash. A piece of a shell of a Middle Cambrian phosphatic specimen of *Acrothele* when tested in the same way did not burn. The close association of lenticles of coaly matter in the Banjari lime-

stones and the carbonaceous discoidal bodies and the similarity of their structure in thin sections strongly leads us to the suggestion that the discoidal bodies described here probably represent plant remains.

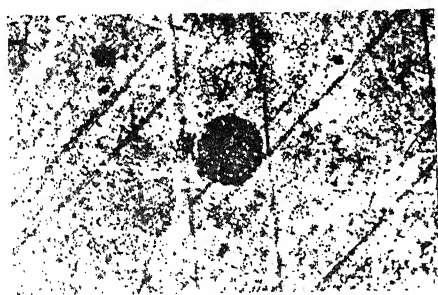


FIG. 2. Spherical body of 'ALGAL DUST', in Carbonaceous Rohtas Limestone. $\times 60$.

Loc.— Banjari, Shahabad District. Bihar.

2. *Algal Dust*.—Thin sections of the sandy glauconitic limestones of the Lodwara hill ($25^{\circ} 13' - 80^{\circ} 55'$) overlying the Bundelkhand granite, and the carbonaceous Rohtas limestones from the Banjari quarries, (south of Dehri-on-Sone, on the Dehri-Rohtas Light Railway) show dusty and dark patches and rounded discs in a clear matrix of grains of calcite, by transmitted light. By reflected light these appear porcellaneous, similar to the 'Algal Dust' described by Alan Wood⁷ from the carbonaceous limestones of England. They are not carbonaceous, as pointed by Wood, they consist of minute grains of Ca CO_3 precipitated by the action of algæ. The spherical nature of the microscopic dusky bodies (maximum diameter $\cdot 145$ mm.) in our material suggests some connection with algal spores.

We are highly indebted to Prof. S. R. Narayana Rao, under whose guidance this work is being conducted.

Dept. of Geology,

University of Lucknow,

Lucknow,

January 31, 1950.

R. C. MISRA.

G. S. BHATNAGAR.

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ELASTIC CONSTANTS OF FUSED QUARTZ

The elastic constants of fused quartz have been determined in the past by the well-known

static method. However, independent determinations show wide variations amongst themselves. We have now determined these constants by three other methods; one is based on the thermal scattering of light, while the other two are dynamic methods based on ultrasonic excitation. Recently one of us¹ has succeeded in photographing one pair of Dopp'ler shifted Brillouin components in the light scattered by fused quartz using $\lambda 2533$ excitation and a quartz 3 metre spectrograph. The shift of the components, as is well known, is related to the velocity of the sound waves which in turn depends on the elastic constants of the medium. The observed shift for transverse scattering was equal to $\pm 1.65 \text{ cm.}^{-1}$ Using this value and the known refractive index of fused quartz, the elastic constant C_{11} is evaluated and entered in the accompanying table.

Using a thin plate of fused quartz, the elastic constants have also been determined by exciting the same at its mechanical resonant frequencies by a piezo-quartz plate of uniform thickness (Plate method).² The values of the elastic constants calculated from the observed resonant frequencies and the thickness of the plate are also given in the table. Lastly, the values of the elastic constants of fused quartz as determined by the well-known Schæfer-Bergmann³ method are also entered in the same table. The specimens used in the above three methods are of the same origin. The agreement between the results obtained by these three methods is satisfactory.

No.	Method	$C_{11} \times 10^{-11} \text{ dynes/cm.}^2$	
		$C_{11} \times 10^{-11}$	$\frac{C_{11} - C_{12}}{2} \times 10^{-11}$
1	Light scattering	7.70	..
2	Plate method	7.85	3.05
3	Schæfer-Bergmann method	7.97	3.12
	Static method	7.38	3.05

The last row in the table gives the most probable values⁴ of the constants as determined by the static methods. As is to be expected, the dynamic values are slightly higher than static ones.

Physics Dept.,
Ind. Inst. of Sci.,
Bangalore,
March 10, 1950.

R. S. KRISHNAN.

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K. VEDAM.

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VANADAMETRY—PART VI Volumetric Estimation of Hydrazine with Sodium Vanadate

THE reaction between hydrazine and vanadic acid has received comparatively little attention, although, it was considered suitable by Hofmann and Kuspert¹ for the estimation of hydrazine as early as 1898. Browne and Shetterley² and Bray and Cuy³ dismissed the method as being inaccurate, although the latter workers made the significant statement, "A weighted mean of all the results gave for the concentration of hydrazine solution the same value as that obtained later by the iodic acid method. This check is considered to be accidental and due to a compensation of errors". No details of the method were mentioned.

The present communication deals with the estimation of hydrazine with sodium vanadate solution. An excess (50 per cent. more than the required amount) of standard sodium vanadate (about 0.1N) solution was taken in a conical flask, enough sulphuric acid added to keep the overall concentration at 2N, and then the hydrazine solution was added. The mixture was heated to boiling, cooled and the excess vanadate titrated with a standard solution of Mohr's salt using diphenyl benzidine as the indicator. In another series the vanadyl salt formed by reduction of vanadate was determined by titration with standard potassium permanganate while hot. Both the procedures gave satisfactory results, although the former is more convenient. Preliminary experiments have shown that hydrazine sulphate cannot be titrated directly by running down sodium vanadate solution from the burette, either in the cold or in the hot (50° C.) as the reaction is not rapid enough, the first drop of vanadate solution giving the characteristic blue violet colour.

The results obtained by the Vandametric method compare most favourably with those by the potassium iodate method recommended by Jamieson⁴ and Pennemann and Audrieth.⁵

Fuller details will be published elsewhere.

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Andhra University, & V. BRAHMAJI RAO.
Mrs. A. V. N. College, G. GOPALA RAO.
Visakhapatnam,
January 24, 1950.

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CONTROL OF SECONDARY INFECTION OF DOWNY MILDEW OF MAIZE

THE damage caused by downy mildew of maize was, according to report, very severe in Java and Belgian Congo,¹ while in India it was estimated to be slight by Butler¹, and by about 10% McRae². The disease appeared in a severe form in September 1949 in a block of seven acres of maize in the area of the Indian Agricultural Research Institute, New Delhi. The incidence of the disease was 100 per cent and it appeared that the crop would be a failure. The affected plants showed stunted growth, the upper part having turned pale yellow owing to the disappearance of chlorophyll in the leaves in long streaks. Two distinct types of symptoms were visible, the chlorosis being more pronounced in one than in the other. The incidence of the severe type was about two per cent. The fungus was identified as *Sclerospora philippinensis* Weston.

Examination of the growing points of severely affected plants showed the presence of fungal hyphae suggesting that the infection in these cases was systemic. In case of the plants showing milder type of infection hyphae could not be traced in the growing points. The infection in such cases was probably secondary.

Spraying with Bordeaux mixture 5-5-50 was undertaken with a view to control the disease. The crop within a period of ten days after the spray, regained its normal colour. The severely affected plants did not recover from the disease. Even a second spraying failed to eliminate the disease from these plants. It, therefore, appears that secondary infection by downy mildew of maize can be controlled by spraying with Bordeaux mixture.

The writer is indebted to Dr. R. S. Vasudeva, Head of the Division of Mycology, Indian Agricultural Research Institute, for his helpful suggestions and criticism.

Division of Mycology and M. L. GATTANI.
Plant Pathology,
Indian Agri. Res. Institute,
New Delhi,
January 14, 1950.

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PURITY OF MILK

THE variations in surface tension of milk with adulteration are only slight, even upto 60%, according to Mahajan and Mathur¹: naturally,

TABLE I

Viscosity of whole and skimmed milk with different adulterations at 19° C.
(Buffalo Milk)

Sample No.		1	2	3	4	5	6	7	8	9	10	Mean viscosity (η)
% of water												
Whole Milk	0	1.72	1.76	1.76	1.72	1.72	1.75	1.76	1.74	1.75	1.74	1.74
	20	1.46	1.48	1.49	1.48	1.48	1.47	1.50	1.48	..	..	1.48
	40	1.37	1.39	1.39	1.32	1.33	1.36	1.38	1.36	..	..	1.36
Skimmed Milk	0	1.55	1.57	1.60	1.58	1.54	1.61	1.59	1.56	1.58	1.56	1.57
	20	1.43	1.42	1.44	1.39	1.46	1.45	1.45	1.41	..	..	1.43
	40	1.28	1.30	1.31	1.31	1.30	1.30	1.31	1.32	1.30	..	1.30
50% Whole milk + 50% Skimmed milk												1.66

they are not of much utility for detecting the purity of milk, as claimed by the authors.

We find however that the viscous properties of milk change very appreciably at the above mentioned adulterations. The viscosity was determined by using the 'Ostwald Viscometer'.² The relative times of flow of a measured volume (10 c.c.) of the sample under test and of distilled water between two marked levels on the viscometer were determined and the viscosity (η) relative to water was calculated from the

relation $\eta = d \cdot \frac{t_2}{t_1}$ (taking the density of water and its viscosity as unity); d is the density of milk and t_1 and t_2 are the times of flow of distilled water and the sample respectively. (Table 1).

With the addition of starch, we found that with (i) 1 gm. of starch in 10 c.c. of whole milk, $\eta = 2.53 \pm 2\%$; (ii) 1 gm. of starch in 10 c.c. of whole milk and water added to make the density equal to that of pure milk, $\eta = 1.66 \pm 2\%$.

From the above results it seems that it may be possible to utilize the viscosity determinations as a method for detecting water or starch adulterations. Detailed investigations on the standardisation of the viscometer will be reported in due course.

The authors are grateful to Dr. Sarna, Director of E.P.U. Physics Labs. for providing facilities; Mr. M. L. Lakhanpal for loan of the apparatus and Dr. Ram Chand for useful discussions. The investigation was financed by the senior author (O.P.)

E.P.U. Physics Dept.,
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Hoshiarpur, E. Punjab,
February 6, 1950.

OM PRAKASH.
RAM.

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A SIMPLE METHOD FOR THE REMOVAL OF THE TOXIC ALKALOIDS FROM MUSTARD OIL ADULTERATED WITH ARGEMONE OIL

THE ingestion of mustard oil adulterated with argemone oil was found by Lal & Das Gupta¹ to be the causative factor of 'epidemic dropsy' in India. Argemone oil was reported to contain a substance of an alkaloidal nature² which was identified recently by Sarkar³ to be a mixture of dihydro-sanguinarine and sanguinarine respectively. Sanguinarine was very toxic to rats and induced symptoms similar to those observed in cases of epidemic dropsy. The present note deals with a method by which the alkaloids of argemone oil can be easily eliminated from mustard oil adulterated with it, keeping the edible properties of the mustard oil unimpaired.

Pure mustard oil was adulterated with varying percentages of argemone oil expressed in our laboratory and was used for these experiments.

The oil could not be freed from the alkaloids by direct treatment with adsorbents such as activated alumina, silica gel or Fuller's earth or by heating it to 230° C. for about 15 minutes⁴; nor was it found possible to precipitate the alkaloids from the adulterated mustard oil with some of the edible salts of different metals such as ferric sulphate, ferric chloride, calcium phosphate, calcium oxide, acid potassium phosphate, etc., or by the ordinary alkali treatment.

A partial separation of these alkaloids was however observed on treating the adulterated oil with some organic acids. Inorganic acids such as boric and phosphoric, which are considered to be the least harmful amongst edible inorganic acids, were therefore tried and it was observed that treatment of the adulterated mustard oil with pure phosphoric acid, the amount varying according to the percentage of adulteration with the argemone oil (about 1 to 1.5% of phosphoric acid for 10% adulteration was found satisfactory) at the ordinary temperature removed practically the whole of the alkaloids as insoluble phosphates together with little albuminoids and colouring matter of the original oil. Traces of alkaloids still remaining in the oil could be completely removed by shaking this acid-treated oil with about 2 per cent. of acid-activated Fuller's earth and filtering it through a filter press.

Excess of phosphoric acid in the oil was finally neutralised by the addition of a requisite amount of precipitated chalk and filtering the oil again through the filter press. The oil thus purified was found free from any alkaloid and gave neither any colour reaction with nitric acid nor produced any reddish brown flakes with the ferric chloride reagent of Sarkar⁵. The 'characteristics' as well as other physical properties of this treated oil differed little from those of the pure mustard oil excepting that a slight fading of colour and odour and a little reduction in specific gravity were noticed.

Detailed results of this work are awaiting publication elsewhere.

My best thanks are due to Dr. K. R. Krishnaswami, Director of Industries, Bihar, for his helpful criticism and advice and to Mr. S. K. Das Gupta for assistance in the analytical work.

Prov. Ind. Res. Lab.
Science College,
Patna,
December 23, 1949.

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METHIONINE AND CYSTINE CONTENTS OF THE GUINEA FOWL EGG
GUINEA fowl (*Numida meleagris*) belongs to the order and family: *Numididae*.

The bird whose eggs were procured for this investigation was fed *jawar* at home, and then it fed freely elsewhere. No specific diet could

be arranged for this investigation, since guinea fowls, as a rule, do not lay eggs in captivity.

The white of the egg and the egg yolk were separated according to the method employed by Plimmer and Rosedale (*Biochem. Jour.*, 1925, **19**, 1015) and dried. Total sulphur in these two portions was estimated by using sodium peroxide bomb, and cystine and methionine according to the specific methods of Callan and Toennies (*Ind. and Eng. Chem., Anal. Ed.*, 1941, **13**, 450) and Horn, Jones, Blum (*Jour. Biol. Chem.*, 1946, **166**, 313) respectively. Estimations were made in the case of egg yolk after it was treated with ether to extract ether-soluble fat. But since in literature references are given to egg yolks from which fat has not been removed, values obtained have been calculated to correspond to this. The results are given in the following table:

TABLE I

		Total sulphur %	Cystine sulphur %	Methionine sulphur %
Egg white	..	2.294	1.199	0.4107
		2.189	1.217	0.411
Mean	..	(2.2415)	(1.208)	(0.4108)
Egg yolk	..	2.511	1.015	0.4939
(Freed from fat)		2.449	1.005	0.4901
Mean	..	(2.480)	(1.010)	(0.4920)
Egg yolk, calculated, on the basis that the fat was not moved		1.698	0.6916	0.3370
Total, for whole egg if the fat is not removed		3.9395	1.8996	0.7478

Unpublished work (Block and Bolling: Amino Acid Composition of Proteins and Foods, 1945 Edn., page 181) gives for whole hen egg, S, 1.5; cystine S, 0.6351; and methionine S, 0.8583 per cent. whereas Beach and Teague (*J. Biol. Chem.*, 1942, **142**, 277) find in egg white alone S, 1.9; cystine S, 0.8467; and methionine S, 0.9446 per cent. In any case, guinea fowl egg appears to be richer in the total sulphur and cystine sulphur content.

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BRANCHED EARS IN *PENNISETUM* *TYPHOIDES* STAPP ET HUBBARD

We observed within an year two instances of branching inflorescence in bulk rainfed crops. A specimen with eleven branches was found at the Agricultural Farm, Coimbatore. These

cases of branching have been obtained under normal field conditions without X-irradiation or photoperiodic treatment.^{1,2} The branching was



not found in any one of the hundred and odd progenies raised from the seeds collected from the plants with forked branches. No explanation of the above phenomenon can be offered at present. The authors will be glad to hear of similar observations from others.

Botany Section, S. N. CHANDRASEKHARAN.
Agric. Coll. & Res. D. DANIEL SUNDARARAJ.
Instt., Coimbatore,
January 16, 1950.

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A MANGO CHIMAERA

THE mango variety *Alphonso* is cultivated on a large scale in the Bombay Presidency by grafting on seedlings used as root stocks. These occasionally exhibit chimæral nature.^{1,2,3,4,5,6,7} In one case, a branch about 10 inches long bore two fruits of quite different shapes—one of the typical *Alphonso* type and the other having a prominent shoulder and a deep ventral cavity, these features being absent in the typical *Alphonso* fruit. It appears to be a case of mericlinal chimæra and during the fruiting season of 1949, almost all the fruits borne by the tree were found to be of the typical *Alphonso* type, except one which was of the type as described above. Further investigation is

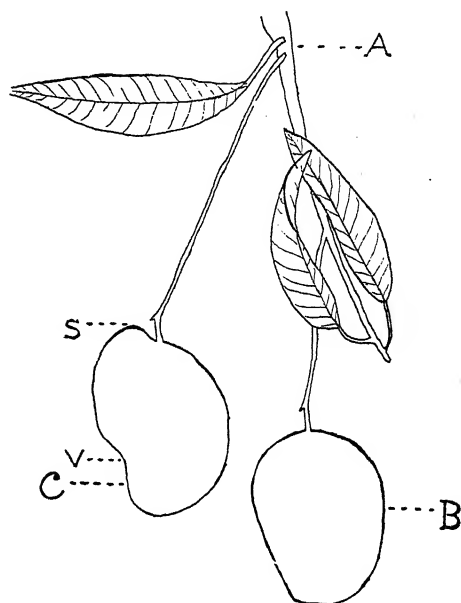


FIG. A—A branch of an Alphonso tree (a Mango Variety) B—Fruit of typical Alphonso type. C—Fruit of another type with shoulder (S) and Ventral Cavity (V) necessary to decide its mode of origin i.e., whether it is autogenous or graft chimæra.

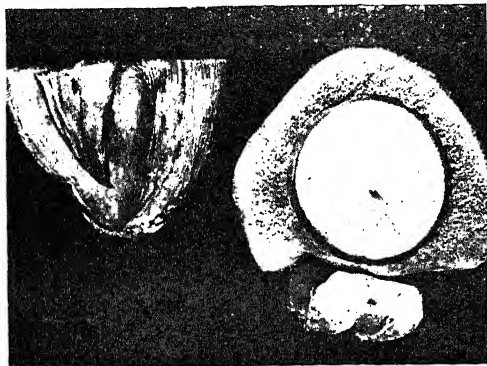
M. A. C. S. Laboratory, BASUDEV ROY.
Poona 4,
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DOUBLE OVARY IN *COCOS NUCIFERA* LINN

THE occurrence of double ovary in coconut not reported so far was observed in a coconut fruit with a big "horn" like structure, brought by a student from Tenkasi in Tinnevely Dist. The 'horn' was of strikingly big size and the length nearing that of the main fruit. The fruit and the 'horn' were sawn into two to study the internal structure (cf. Figs. 1 & 2). The bigger fruit was normal in section with the epicarp, the

fibrous mesocarp and the hard endocarp enclosing the kernel. The 'horn' also possessed the above three distinct layers of the fruit; but the endocarp was solid in structure and about 0.25 cm. in thickness.

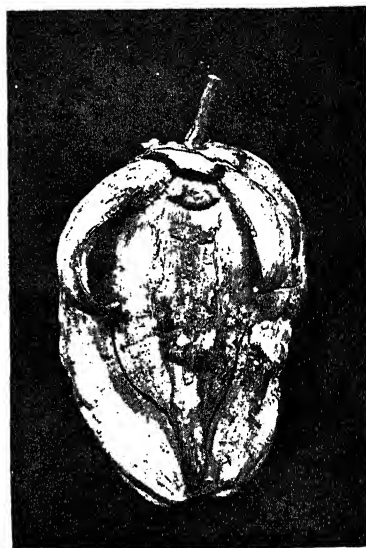


While the presence of the endocarp gave the indication that the 'horn' is a developed ovary, possibility of its being developed from an apocarpous pistil was investigated. The bigger nut in the present case, on detailed examination, showed that it was normal with three carpels. Hence the 'horn' is not due to any one of the carpels being apocarpous.

'Horned' coconuts (similar to Fig. 3) have been recorded; but regarding the morphology of the horns there is considerable difference of opinion. Masters (1869) considered that they may be due to hypertrophy of perianth segments. Petch (1924) favoured the view that the horns are due to a 'duplication of the segments of the gynœcium.' The generally accepted theory is that of Furtado (1927) who attributed the horns to the development of the staminodes. But the present case is quite different, as the normal ring of staminodes was made out in the younger flowers which were later examined.

The female flowers examined at different stages of growth showed the double ovaried

condition in most of the cases. The presence of the hard endocarp in the "horn" also goes to prove that it is developed from a separate ovary. It is of interest that this plant, found in a plantation in Tenkasi produces mostly female flowers with the twin ovaries developing into fruits with horns.



The authors wish to thank Sri. G. V. Narayana, Oilseeds Specialist, Agricultural College and Research Institute, Coimbatore, for his kind help in this investigation.

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Botany Section,
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Coimbatore,
January 12, 1950.

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UNESCO CONFERENCE ON BRAILLE PROBLEMS

AN International Conference on braille problems is being convened by the United Nations Educational and Cultural Organization (UNESCO) from March 20 to 29, 1950. The Director-General of UNESCO has invited Prof. Suniti Kumar Chatterji and Mr. P. M.

Advani, Members of the Indian Expert Braille Committee, Mr. Lal Advani, a blind Brailist and Mr. K. V. Padmanabhan, first Secretary, Indian Embassy, Paris, to represent the different linguistic areas of India at the conference.

REVIEWS

A General Kinetic Theory of Liquids. By M. Born and H. S. Green. (Cambridge University Press), 1949. Pp. 98. Price 10 sh. 6 d.

The six articles published by the authors during the years 1946-48 in the *Proceedings of the Royal Society* are now issued in book form, by way of meeting the great demand for reprints. The subject-matter is the statistical theory of liquids for a proper description of equilibrium and dynamical properties.

In the first article a mathematical formulation of the problem has been made. A complete set of distribution functions for singlets, doublets, triplets, etc., of molecules depending not only on position and velocity, but also on higher derivatives with respect to time has been introduced. The equations of continuity and the equations of motion have been obtained. It is assumed that the intermolecular forces are central. The theory could however be generalised even if the forces are not central ones. If only binary encounters between the molecules be considered, Boltzmann's equation is shown to follow from the equations of motion. The results of the equations of equilibrium are shown to be in agreement with the results of statistical mechanics. In the next paper a generalisation of the famous Boltzmann H-theorem has been made and an explanation of the phenomenon of condensation and the distinction between the liquid and gaseous phases is given.

In the third article the theory of the dynamical properties of liquids has been developed. A set of generalised hydrodynamical equations has been established. It is shown that the pressure tensor and the energy flux vector consist of two parts, one due to the thermal motion and the other due to the intermolecular forces, the former being dominant in the case of gases and the latter in the case of liquids. Expressions for viscosity and thermal conductivity have been found. Born and Green have explained the phenomenon of condensation as connected with the appearance of analytic singularities in the equilibrium equations and the dynamical constants.

In the fourth article the theory developed in the preceding papers has been translated into the quantum formalism. The classical limit is established and a quantised proof of the Boltzmann law is given. The equation of state shows clear differences at low temperatures. A discussion of the viscosity and the thermal

conductivity of quantum liquids is given, thus offering an explanation of the abnormal properties of liquid He II. The authors point out that the previous attempts to explain the properties on the basis of Bose-Einstein statistics are not successful as the interatomic forces have been neglected.

In the fifth paper the thermodynamic properties of systems of arbitrary nature and kind have been established on the basis of quantum mechanics. Entropy is defined and shown to be additive for weakly coupled systems and the general H-theorem is established.

In the last article, Green has examined the theory with special reference to liquid He II. The author has pointed out that all the properties of He II can be explained by his theory in a way satisfactory to physical intuition and calling for no further assumptions than the accepted laws of quantum mechanics.

There is no doubt that the contribution of Born and Green to the kinetic theory of liquids is a classic one, as it offers a mathematically satisfactory description of the laws of the dynamic and equilibrium properties of liquids, a satisfactory account of the laws of thermodynamics from the kinetic point of view and a satisfactory description of quantum liquids. The papers require careful study as they are highly mathematical.

N. S. NAGENDRA NATH.

Modern Radio Technique. A New Series. Edited by J. A. Ratcliffe. (Published by the Cambridge University Press), 1949.

1. *Aerials for Metre and Decimetre Wavelengths.* By R. R. Smith. Pp. xiii + 218. Price 18 sh. nett.

2. *Recent Advances in Radio Receivers.* By L. A. Moxon. Pp. x + 183. Price 18 sh. nett.

The War years saw a remarkable development of the Radio Technique reflected in the enormous amount of valuable material published in the technical journals since 1945. A number of very valuable books, both advanced monographs and texts, has also appeared from the United States, but the texts do not contain everything, and advanced treatises are beyond the reach of the average student who has examinations to consider and has a limited time at his disposal. Same is the fate of the professional engineer who was familiar with radio technique before the War and who has now little time to

spare to make his knowledge up to date. To these classes, the books published in this series on Modern Radio Technique are a boon. They are written by persons who have themselves made valuable contributions. They are brief and confined to the broad fundamentals. Yet there is enough of all the valuable material that one desires to get familiar with. As one reads through them, one cannot escape noticing the expert hand of the editor who is known to all of us who had the privilege to be his students as an excellent teacher. The books are, therefore, most welcome and constitute a very valuable addition to available literature. No library meant for physics or electrical engineering can afford to do without them. To the students, the series is indispensable.

Smith's book on aeriels for metre and decimetre wavelengths is divided into fifteen chapters and covers a wide ground in a most readable manner. Starting from the resonant dipole and the theory of radiation, aeriels, aerial arrays, reflectors, high power transmitting aeriels, receiving aeriels, long wire aeriels, wide band aeriels, slot aeriels, etc., all come up for a balanced and authentic treatment. The book is thus complete in itself for this field. But the reviewer feels that helical antenna should have come up for treatment in a book of this kind.

Moxon's book on Recent Advances in Radio Receivers has really too ambitious a title. Five chapters are devoted to the Noise Factor and this question is gone into in great detail. There is very valuable and useful material here and there could have been a book on this subject only. There is a chapter on I.F. amplifiers, one on Trends in Practical Receiver Design, one on Some New Kinds of Receivers, one on Some New Circuit Tricks. These chapters cannot be considered exhaustive and constitute a weaker link in the book. While it is admitted that it is difficult to draw a line as to how far one can go into details in this field and that valuable literature is difficult to have access to, one cannot refrain from saying that they are rather sketchy. All these chapters have valuable material presented in a very readable form, but none of them can be labelled as complete.

The printing and get-up of the books are excellent. The diagrams are very carefully drawn and well reproduced. In fact, there is very little room for improvement in this direction. The price of the books, viz., 18 sh. is rather high and it is to be hoped that this will be reduced when the books go into the second edition.

S. V. CHANDRASHEKHAR AIYA.

"Laboratory and Workshop Notes". Compiled and Edited by Ruth Lang. (Edward Arnold & Co.,) Pp. 272+xii. 1949. Price 21 sh. Nett.

Under the title "Laboratory and workshop notes", the Journal of Scientific Instruments has been publishing for the last 25 years as a regular feature, many practical devices and tips generally useful in all research laboratories and workshops. Thereby has been built up a collection of simple, low-cost, elegant and time-saving devices, which have been developed and tested in different laboratories in the course of specific investigations, but which are of common interest and adaptability to others. Informations of this type cannot frequently be incorporated in detail in the body of a research report or publication, as they are comparatively of minor importance and have to give place to more important aspects of the specific research under consideration. Such little details however are extremely interesting and useful and are generally freely interchanged between investigators.

The Institute of Physics has been doing a great service in making such information more widely available through the medium of the journal. It has now taken up the additional step of publishing them in book form, after classifying them suitably, and with a general index.

Dr. Ruth Lang, who was invited to undertake this work has carried out the task in a manner which will be appreciated universally by all Laboratory Scientists. 181 "Notes" have been selected, and classified under eight sections, viz.: (1) Laboratory and workshop tools, processes and devices, (2) Clamps, supports and agitators, (3) Soldering, bracing and welding, (4) Technique for glass manipulation and silvering, (5) Vacuum and pressure technique and devices, (6) Electrical and magnetic devices and techniques, (7) Optical devices and techniques, (8) Devices for liquids and gases.

To the younger generation especially, the collection will be something of a treasure chest in which to delve for aids to solve the various "little" practical difficulties that arise, particularly in these days when instruments are difficult to get, or are too costly. This volume should be made available in every College and Research laboratory and would indeed be a valuable *vade mecum* for every individual, for laboratory work. The book is well brought up with clear drawings and sketches, and pleasant to read. The royalties from its sale are

reported to be earmarked for the Benevolent Fund of the Institute of Physics.

M. A. G. RAU.

Principles of Physics. III. Optics. By F. W. Sears. (Addison-Wesley Press Inc., Cambridge 42, Mass), 1948. Pp. 369. Price \$6.

The book is written for the two year course in General Physics at the Massachusetts Institute of Technology. In this third edition (the first edition was published in 1938 and the second in 1945), several important changes have been made in the order of presentation.

As a text-book of optics, it satisfies the requirements of those students who take physics as the only main subject for the B.Sc. course. Besides the usual chapters in geometrical and physical optics, there are four additional chapters which extend greatly the interest and importance of the book. These are devoted to line spectra, thermal radiation, photometry and colour. The last two chapters present a wealth of detail on illumination engineering and modern colorimetry, which should prove useful to every student of Physics.

Special mention may be made of two interesting aspects. The diagrams are neat and well drawn, with relevant details fully indicated under them. The reader is enabled to understand them without having to look up the text for reference. Further at the end of each chapter, there are several interesting and well-chosen problems. Students of optics would do well to work them out completely.

On two important issues, the reviewer is not in agreement with the author. First, there seems to be no essential justification for taking up polarisation before interference and diffraction. The basic ideas of polarised light, double refraction and light scattering are obviously difficult for the student to comprehend at the beginning and may be profitably kept over till interference and diffraction are finished.

The letter symbols used in geometrical optics are those recommended by the Committee on letter symbols and abbreviations of the American Association of Physics Teachers. One is inclined to prefer the symbols used in British text-books like those of Preston and Edser as much less confusing.

These are matters of opinion. The book is no doubt a welcome addition to the current text-books on optics.

S. R. R.

Bibliography of Research on Heavy Hydrogen Compounds. Compiled by A. H. Kimball and Edited by H. C. Urey and I. Kirshenbaum. 1st Edition. (McGraw Hill Book Co., Inc., New York), 1949. Pp. xiii + 350. Price \$3.25.

Ever since its discovery by Urey and his colleagues in 1931, heavy hydrogen (deuterium) has been widely used in one form or other for tracer work. This is mainly due to the comparative ease with which it can be concentrated and the rapidity with which it can be analysed not only with the help of the mass spectrometer but also by the inexpensive and simple falling drop method which takes advantage of the density of heavy water. Thus, for instance, heavy hydrogen and its compounds have been extensively used to test the validity of various theories, where mass effects were suspected: they have also been used in chemical and biological researches such as the one carried out so brilliantly by Schoenheimer and his co-workers on the dynamic state of body constituents. With such diversity of application resulting in the publication of over two thousand papers on the subject, one has reason to welcome a bibliography such as the present volume under review, prepared in the National Nuclear Energy Series, under the auspices of the Manhattan Project and the Atomic Energy Commission of the U.S.A.

The book is a compilation of references to literature published on heavy hydrogen and its compounds and records the achievements of thousands of investigators in different parts of the world. The references are arranged alphabetically according to the name of the senior author of each work. The material has, in addition, been classified according to subject and to help those who may be interested in any particular deuterated compound, a compound index has also been given. Each reference is also identified by a codified letter symbol denoting a particular topic in the subject index. These useful additions serve the purpose of giving a comprehensive picture of the content of each paper and thereby making the bibliography commendably complete in all respects.

References to nuclear reactions as such involving the use of heavy hydrogen have not been included in this volume. There is also no indication as to the year up to which the bibliography is complete and whether the authors plan to bring out an addendum after a definite period of time to include references to recent literature on the subject. In going

through this compilation, one is also puzzled as to where the journals like *Priroda* and *Chem. Obzor* (p. 216) are published and whether *J. Phys. Chem. U.S.S.R.* and *Acta Physico-chem. U.R.S.S.* (p. 38) are published in one and the same country. It will indeed enhance the value of this book, if an appendix is attached giving the details of where the journals referred to are published.

The get-up of the volume is excellent and the extensive bibliography presented in this volume should prove invaluable to all concerned with researches on heavy hydrogen and its application to specific problems.

P. S. SARMA.

The Analytical Chemistry of Industrial Poisons, Hazards and Solvents. By Morris B. Jacobs. Second Edition. (Interscience Publishers, New York), 1949. Pp. xviii + 788. \$12.00.

The first edition of this important book appeared in 1941 and was reprinted twice. The present edition is larger by about 130 pages and has been thoroughly revised. With the growth of the chemical industry, increasing numbers of raw materials and intermediates are being used, and a knowledge of the hazards of chemical manufacture is especially necessary for countries which are relatively inexperienced.

Following an introductory chapter on the general aspects of industrial hygiene, sampling methods, measurement of gas volume and quantity, the use of absorbents and the estimation of dust are treated in detail in four chapters. An excellent account of the properties and analysis of inorganic poisons is contained in five chapters, while the remaining eight chapters deal with the industrial hazards, physiological action, detection and estimation of a series of organic compounds. Industrial solvents are treated very fully. References to original literature are profuse, and the book as a whole is a scholarly contribution which will be of great value to every one who has to handle chemicals.

Antimony trioxide is much more important than the sulphides as pigment, but it is not mentioned. A serious omission is DDT, the use of which as an agricultural and domestic insecticide is now so widespread. The statement that the principal commercial toluidine is the *ortho* compound is erroneous. Nitrobenzene is a largely used solvent in the dyestuff industry and the more serious hazards are in handling nitrobenzene as a solvent at high temperatures. The toxic properties of benzidine, the chlorotoluidines

and the naphthylamines should have been mentioned. According to Goldblatt (*British Medical Bulletin*, 1947, 4, 405), "the manufacture of benzidine should be regarded integrally as a hazard from start to finish, and the base should be prepared only if the plant design is such as to preclude absolutely any maintained contact with, or exposure to, dust of the final product." The convenient, although non-specific, bromine absorption method for estimating styrene is not mentioned.

Several errors in printing have been noticed, such as 'naphthaline, carmium, momoxide and sterol' (for styrol or styrene). Pages 361-92 are missing, and have been replaced by pages 523-54 in the reviewer's copy. Carbon tetrachloride and amyl acetate are not solvents for lac. Chloroprene is 2-chloro-1:3 (and not 1:2)-butadiene. On p. 688 and 704 (lines immediately below equations), 6 mols. of iodine and bromine should read as 3 mols. or 6 atoms. The equation on p. 718 is incorrect.

K. V.

Thermodynamics Rewritten. By S. K. Dhar. (The New Sketch Press, Dhanbad), 1949. Pp. 34. Price Re. 1.

Some books are to be chewed and digested while others are to be eschewed. The small booklet under review clearly belongs to the latter category. In spite of the large bibliography of standard books at the end of the booklet, the author does not appear to have fully grasped the theory that he attempts to criticise. From the start, there are instances of confusion between reversible and irreversible processes and between a system in equilibrium with its surroundings and a strictly isolated system. This is clearly shown in the examples indicated in the second chapter. The third and fourth chapter similarly indicate the author's limitations. If he had only considered the fact that in the Electrolux where the working substance is a solution of ammonia the energy requirements for maintaining the same degree of refrigeration is much more than with other forms of refrigeration, the chapters would not have been written! The statistical basis of the Second Law, and variations of the heats of reaction with temperature do not appear to have reached the author and the crowning tragedy is seen in his chapter on thermochemistry. Production of water gas is an endothermic reaction and if some one does not provide the energy to keep the carbon hot our author's engine will have to stand still in spite of his calculated efficiency.

S. V. A.

The Elements of Genetics. By C. D. Darlington and K. Mather. (George Allen & Unwin Ltd., London), 1949. Pp. 446. Price 25 sh. net.

This recent publication by two of the foremost geneticists of England will be widely welcomed by all students of plant and animal genetics. The word *Elements* in the title is intended to mean essentials and principles, but the subject is by no means treated in an elementary way. Plant and animal genetics are not separated nor given undue importance, but the science of genetics as a main branch of biology is built up from its elements.

The mode of treatment is analytic as well as synthetic, and not descriptive or experimental. A general knowledge of heredity, cytology and evolution, of both plants and animals, is prerequisite to follow the close reasoning in this book. The labour of following the arguments is well worthwhile, for the authors have so many new ideas and perspectives to present. Such a comprehensive treatment of the subject has probably not been given in any other English book, nor will probably be tried again in this vigorously expanding science.

The subject-matter is divided into three parts, relating to individuals, cells, and populations. In the first part, the mendelian and biometric aspect of heredity is dealt with, and includes the chromosomal basis of inheritance. In the second part, the organisation of cells is discussed in its relation to development and heredity. The topics of this part are Genes, Molecules, Processes, Cytoplasm, Development, Differentiation, Viruses, Proviruses and Conflict of Systems. In this part, very recent and topical subjects such as the relation of cytoplasm to gene action, and the probable biochemical processes of gene action, are discussed. In the last part, the genetic systems as consisting of natural populations of plants and animals are discussed. Also a consideration of human populations and human genetics is included, and scientists of India and Pakistan would be much interested (and probably irritated) by the way the authors sum up the genetic consequences of the Hindu and the Islamic social systems.

On first studying this book, the reviewer felt very strong disagreement with some statements, inferences and arguments. On reading the book again, the treatment adopted was seen to be so able, that it was obvious that any criticism must be carefully considered, and advanced by the expert in the topic concerned. The late Dr. Belling produced a booklet out of his critical notes of Dr. Darlington's Recent Ad-

vances in Cytology. A second Dr. Belling, who is an expert in protein and enzyme chemistry as well as in modern genetics, is needed to prepare critical notes on this book. Only this opinion can be advanced now; the style of the book is vigorous rather than rigorous. The style of some eminent scientists who marshal evidence for as well as against a particular view, is not here adopted, possibly because of the vast extent of the subject to be covered. Those who wish to secure a different view-point have to refer to other books and reviews. Critical readers are to keep in mind the authors' words in the preface, that they have taken "the hazardous method of using the knowledge of a mapped area to fill in the empty spaces with more likely assumptions". In connection with a discussion on the evolution of angiosperms as revealed by a study of chromosome numbers, the authors also state that "conjectures conjoined become verifiable predictions".

The glossary of technical terms given as Appendix I, to the book is a very useful addition. The technical terms, as well as the English language, have been used with great skill throughout the book, as can be expected from the authors. In spite of this skill, there is some obscurity in construction, possibly because Indian language construction and modes of thought are different. Three examples of the unusual use of words may be cited. "Broken tulips" in page 209, refers to tulips affected by a specific virus. The statement "This supergene is Sex-Ratio" is difficult to understand even if the definitions of both the words are learnt. The title "The special uses of Man" in page 349 refers to advantageous features in human genetics. The large number of figures used to illustrate the text are of great help, but few like Fig. 87, p. 357 are obscure.

The get-up of the book is excellent. Only printing mistakes detected are two omissions of letter 'B' on page 378.

C. G.

Manual of Bacterial Plant Diseases. By W. J. Dowson. (Adam & Charles Black, London), 1949. Pp. 179. Price 16 sh.

Dr. Dowson's book meets the long felt need of the student of plant pathology. It is true that a greater number of workers are engaged in the study of fungal diseases than of bacterial diseases of plants. This is no doubt partly due to the abundance and easy availability of literature on fungus diseases.

The book is divided into 12 chapters, the 1st four chapters dealing with general characteris-

tics of bacteria, nomenclature, methods of investigation etc. The nomenclature of bacteria seems to be a never ending controversy, and it is doubtful whether Dowson's treatment of *Erwinia* as synonym of *Bacterium* will find general acceptance. Chapters five to seven are devoted to general staining and cultural methods of studying bacteria which are concisely and neatly presented.

In chapters eight to twelve, important bacterial diseases of several economic plants are given. For several of the important bacterial plant pathogens, distribution, symptoms, etiology and control of the disease are given. A brief account of the morphological and cultural characteristics of the bacteria would have been a welcome and useful addition. The photographs illustrating the disease symptoms are excellent. There are eighteen distribution maps included in the last chapter. Too much credence however should not be placed on these, since there is the possibility of the pathogene having been overlooked in a particular locality. As an instance in point, *Xanthomonas campestris* inciting black rot of cabbage is common in Northern India, introduced perhaps from imported seeds. By solely relying on the distribution maps one is led to believe that it does not occur in India at all. This book should be welcomed by all students and investigators in plant pathology.

M. J. NARASIMHAN.

The Chemotherapy of Tuberculosis. The Experimental Approach. By Max B. Lurie, Geoffrey Rake, Richard Donovan, Selman Waksman and 31 other authors. *The Annals of New York Academy of Sciences*, Vol. 52. Art. 5. Pages 625-788. (New York: Published by the Academy). December 14, 1949. Price \$2-50.

The publication—Vol. 52. Art. 5 of the *Annals of the New York Academy of Sciences*—is a collection of scientific contributions and reports of researches on the experimental approach of Chemotherapy of Tuberculosis. Distinguished workers who are actively engaged in the field have contributed to this important subject in the volume under review.

It is interesting to note that an attempt has been made to include in the programme those aspects of the problem that are particularly pressing at this time. Tuberculosis has remained stubbornly resistant to chemical agents and all attempts to treatment of experimental and clinical tuberculosis have not been very promising so far. There are many obstacles that

face the investigators who desire to carry on a comprehensive study of chemotherapy of experimental tuberculosis; but with the development of the modern technics of producing experimentally in animals the disease with fairly identical characteristics and consistent morbid states, a new impetus has been provided for attack on this important problem.

Each contributor has made a clear presentation of his topic with the common objective of arousing a widespread interest in the magnitude of the problem that confronts the experimentalist in tuberculochemotherapy. The use of rabbits, guineapigs, Syrian hamsters, mice and chick in experimental tuberculosis has been fully discussed by different authors. Tuberculosis is a complex immunologic and cytologic response which varies from one species to another and from one animal to another within a species. Karlson and Feldman in their article on "the use of guineapigs" have sounded a note of warning that one should be careful and reserve judgment about the clinical use of any chemotherapeutic agent found effective in susceptible animals. To obtain as complete an information as possible regarding the efficacy of anti-tuberculosis agents, these should be tested in more than one laboratory animals now available. But still then, one should maintain a conservative attitude and recognise that from the standpoint of chemotherapy, much evidence is needed before the question as to the rationality for successful transfer of results from experimental animal to man can be answered.

Of the thousands of synthetic compounds and drugs of natural origin that have been tested in various ways for their activity against tubercle bacillus very few have shown enough promise to merit clinical trial. Smith, *et al.*, have dealt with the evaluation of the sulphones and streptomycin in experimental tuberculosis. Dealing with experimental evaluation of synthetic drugs French has laid particular stress on the contemporary theories of drug action and on the selection of drugs for screening. Dealing with the drugs of natural origin Hobby *et al.*, have reported methods for the evaluation of neomycin and other antimicrobial agents of bacterial and fungal origin and substances from higher plants. Little can be said at present concerning the chemotherapeutic potentialities of antimicrobial agents that reside in higher plants, yet studies on them serve to emphasise the abundance of such substance in nature and offer great possibilities of finding new agents which will prove to be effective in the treatment of tuberculosis.

The volume represents a very stimulating

contribution to the subject of chemotherapy of tuberculosis and indicates that research in this line offers rich possibilities for the investigators who has energy, imagination, patience and enthusiasm.

N. N. DE.

Bengal Famine (1943)—As Revealed in a Survey of the Destitutes in Calcutta. By Tarakchandra Das, Lecturer in Anthropology, Calcutta University. 1949.

The volume under review records the results of a survey conducted by the author and his trained collaborators on a representative group of 2,537 destitutes that had gathered in Calcutta, as a result of the Bengal Famine in 1943. A number of interesting points emerge from this investigation:—

1. The largest number of persons were in the age-group 0-10 years, the smallest in the group 50-60 years. The sex-distribution of male to female is interesting; in the age-group 0-15 years, males were about 30 per cent. and females 22 per cent. against the Bengal census figures of about 20 and 18 respectively. But in the age-group 15 to 60 years the percentage of males to females in the survey stood at 16 and 30 respectively as against the census figures 32 and 27. The author has discussed the reasons for the high percentage of females in this age group. It was elicited in the survey 32.4 per cent. of the males and 21.4 per cent. of the females of the marriageable age were unmarried and 13 per cent. males and 23 per cent. females were married. In the author's view, the marital status is an index of the economic well-being.

There was no significant difference in the marital condition of the three principal communities among the destitutes. The scheduled castes formed the largest number of the destitutes, being 53.68 per cent., Muslims 27.63, Caste Hindus about 18 per cent. and Christians less than one per cent. The destitutes came from about 12 districts of which the largest were from Howrah, Nadia, Hooghly, Burdwan and Dacca; others being comparatively small. The acuteness of distress was well indicated by the distance covered by the destitutes to reach Calcutta with all the difficulties and obstacles of transport from the distant districts like Dacca. The causes of the destitution and dislodgment according to the destitutes' statements were lack of food and work, floods, cyclone, failure of crops, family dissension, military occupation.

The occupation of the destitutes was mainly agriculture, comprising about 22 per cent., daily labourers 14 per cent., the rest belonging to various arts and crafts. It was observed the rigidity of all social and religious conventions simply vanished during the famine.

The causes of death among the destitutes were found to be starvation, bowel complaints and others. The highest mortality was in the first age-group, infant and children 33 per cent.; the next highest was in the second age-group 15 per cent. It was ascertained that 73 per cent. of the sample population were agriculturists or agricultural labourers. The high mortality among the children will no doubt tell heavily on the next generation of the agricultural population of Bengal, as well as affect its food production very seriously.

Another interesting point observed was that the mortality among the males was higher than among females; this is in conformity with the findings from previous famines in other provinces. The author has given reasons for this feature.

The author concludes by stating the basic and contributory causes of the famine.

2. In Part 2 the author describes a similar survey of a more limited character. This rural survey was of a very restricted character owing to lack of resources. Therefore it was confined to a few villages of some of the seriously affected districts of Burdwan, Midnapur, Hooghly, Howrah, Dacca, etc. Altogether 1,019 families were studied consisting 4,073 persons. 53 per cent. belonged to the scheduled caste, about 29 per cent. were Caste Hindus and 18 per cent. Muslims. In the village data, the sex proportion of the affected population was the same. In the three communities it was found in the village survey the unmarried males were larger in number than the unmarried females. The number of married men is lower than married women. Regarding occupation, the agriculturists formed the highest percentage. Other important aspects: indebtedness, reduction of social status, etc., are discussed. Here again starvation accounted for 80 per cent. of the total number of deaths; the highest number being in the age group 0-5 years.

The memoir is an able presentation of facts collected by a trained team of workers under the expert supervision of the author.

K. P. MENON.

OBITUARY

Dr. N. C. Chatterjee

We regret to announce the death of Dr. N. C. Chatterjee, lately Forest Entomologist, at the

Forest Research Institute, Dehra Dun, on 20th Feb. 1950.

SCIENCE NOTES AND NEWS

Dr. S. L. Hora

Dr. S. L. Hora, Director, Zoological Survey of India, has been admitted as a corresponding member of the Zoological Society of London. Also, he has been invited to serve on the Editorial Board of the journal *Evolution* (International Journal of Organic Evolution published by the Society for the Study of Evolution).

Recognition for L.Ag.

The Government of India have, in consultation with the Union Public Service Commission, decided to recognise the Licentiate in Agriculture of the Government Agricultural College, Kanpur, of the year 1930 as equivalent to the B.Sc. (Agriculture) degree of the year 1931 of that College for purposes of employment under the Government of India.

Unesco Fellowships for Training in Librarianship

As already announced, the United Nations Educational and Cultural Organisation has offered two Fellowships in the fields of librarianship and scientific literature classification respectively, which will enable two scholars from India to undertake study and travel abroad for a maximum period of six months.

Since the previous Press Note on the subject was issued, it has been decided to extend the last date for the receipt of applications for the abovementioned fellowships up to March 31, 1950.

The Government of India have also decided to meet the cost of travel of the selected scholars from India to the country of study. Unesco will provide for the payment of one way travel from the country of study to India.

U. S. Scholarship for Indian Students

The Colorado School of Mines, Golden Colorado, U. S. A., have offered one scholarship to an Indian student to pursue studies in any one of the following subjects: Coal and metal mining, metallurgy, petroleum refining, production and utilization of cement, refractories, clay and other non-metallic minerals. The scholarship is offered for one year 1950-51 and is renewable up to a maximum period of four years. The value of the scholarship is \$ 425 to \$ 475 per annum which covers all tuition fees. It makes no provision for living, transport or other personal expenses.

Candidates must be *bonafide* residents of India and must possess a good degree in Science or Engineering from one of the recognised Universities and technical institutions in India including the Dhanbad School of Mines, West Bengal. Proficiency in English is essential.

Intending candidates must submit their applications in the prescribed forms through their respective Universities or technical institutions so as to reach the Ministry of Education (Section A.I.), New Delhi, not later than April 20, 1950. Copies of the prescribed form can be had from all the universities and technical institutions who have been requested to recommend not more than two names each.

Madras University Prizes

The *Sir William Wedderburn Prize* for 1951 will be awarded by the Madras University to the student who, having qualified in Chemistry for the degree of B.Sc. (Hons.) or M.Sc. not more than two years previously, has shown aptitude for research. A thesis on any research work conducted by the student should accompany the application. The prize will consist of books to the value of Rs. 45. Competitors should submit their theses so as to reach the Registrar not later than 30th April 1951.

The *Maharaja of Travancore—Curzon Prizes* for 1950-51, one in each of the following group of subjects, will be awarded by the Syndicate of the Madras University for the best essay or thesis written by any graduate of the Madras University on any topic dealing with one of the subjects mentioned in the following two groups:

B	C
Botany	Mathematics
Zoology	Physics
Physiology	Experimental Engineering,

The value of each prize is Rs. 250.

Competitors should submit their theses to the Registrar not later than 1st March 1951.

Award of Research Degree

On the recommendation of an Examiners' Board consisting of Sir C. N. Hinshelwood, Kt., F.R.S., Prof. R. P. Bell, F.R.S., and Prof. R. S. Krishnan, the Ph.D. of the Benares Hindu University was conferred on B. N. Prasad, M.Sc., for a thesis on "Comparative Joshi-Effect in Chlorine and Mercury Vapour".

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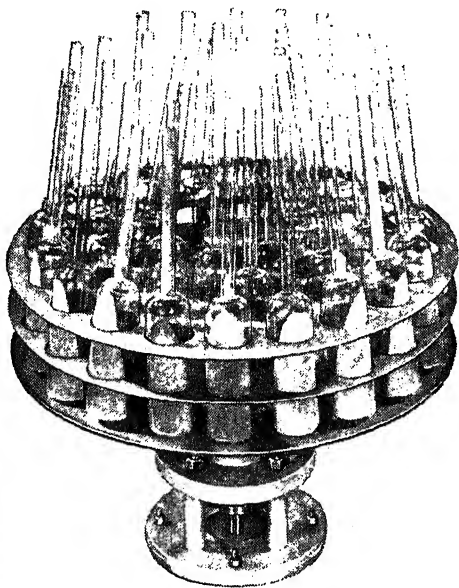
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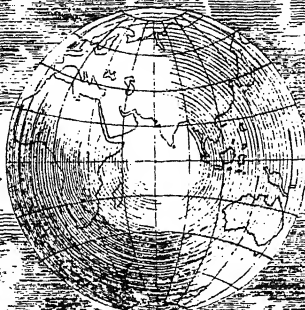
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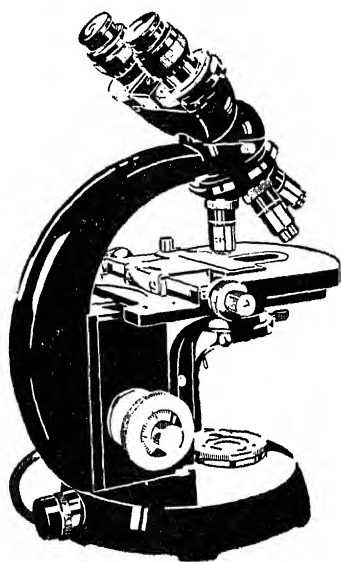
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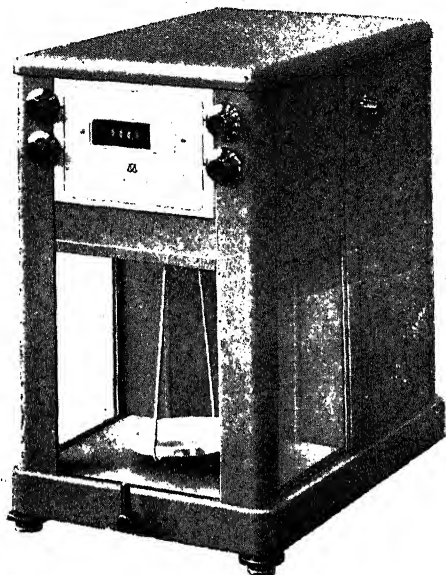
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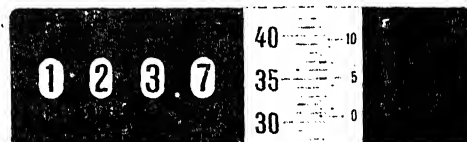
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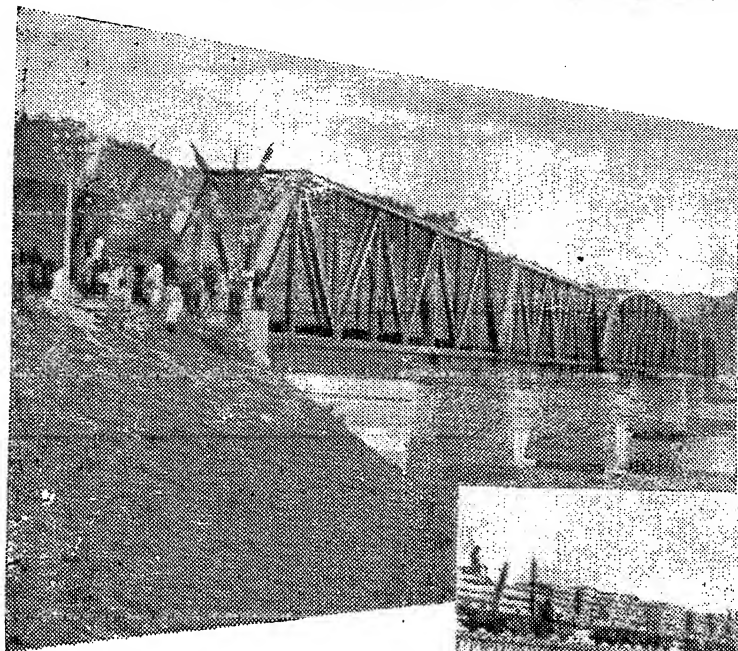
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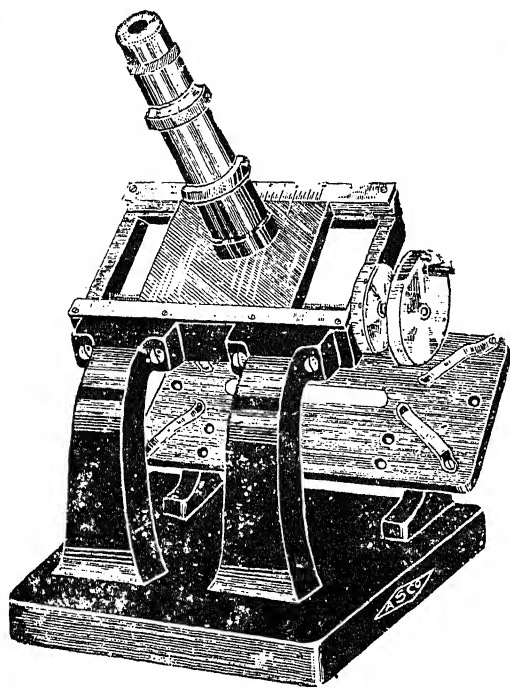
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FORESTRY EDUCATION IN INDIA

SARDAR PATEL'S thought-provoking address at the Convocation of the Indian Forest College, Dehra Dun, early this month, deserves to be assimilated by a much wider public than the handful of young aspiring foresters to whom it was primarily addressed. In his characteristic and forthright manner, Sardar Patel deplored the "cruel exploitation of this vital national wealth (forests) and criminal waste of capital placed in our hands by a bountiful nature". But, he asked, "How few have the attitude of reverence and consideration for the trees and plants that sacrifice themselves in the service of mankind?" And this, in spite of the fact that "forests satisfy our basic needs with a universality which might well be the envy of those who believe in bringing wealth within the reach of all." After a graceful tribute to the work of Dehra Dun, the Deputy Prime Minister had some kindly words of encouragement and advice to the new graduates in the "career" which he exhorted them to regard as "a field of duty".

This address has served a public purpose in focussing attention on the importance of forestry education as an integral part of a sound

forest policy. It will be remembered that the Far Eastern Forestry Conference which met in Mysore a year ago, emphasised the point in a resolution. Again, the Third World Forestry Congress meeting in Helsinki last July gave its considered opinion that "Forestry legislation, research, education of forest owners and workers, and training of a sufficient number of professional foresters and technicians—all in conformity with the constitution and structure of each country—constitute essential elements of such a policy." And Forestry Education is rightly considered to be the keystone of such a policy. It is therefore worth while examining the existing set-up and future possibilities for education in forestry in our country.

The pattern of forest educational policy in India has in the main followed—there are critics who aver that it has been even subordinated—the requirements of Governmental forest services. In general, the top-men were imported and the less attractive posts were open to local talent. It was almost an article of faith that the superior posts needed training abroad. It is worth while recalling that even

under the Montford Reforms, "Forests" were a "Reserved" subject and it was "transferred" to the Ministerial part of Dyarchy as a consequence of the Muddiman Committee Report. The controlling posts of the Forestry Services were almost the exclusive prerogative of the ruling race; these recruits were trained, for the most part, at Cooper's Hill, Bangor, Nancy or Oxford. And, the admission of any Indian into this charmed circle savoured of a favour. These Indian recruits had also perforce to be trained abroad, as there were no institutions in India for training "Officers". The Forestry Colleges at Dehra Dun and Coimbatore trained Indians for either provincial services or as rangers.

It was just about 25 years ago that the Government of India decided upon the inauguration of the I.F.S. course at Dehra Dun—an innovation which was considered almost revolutionary at that time. The experiment was, however, shortlived because on account of the virtual cessation of recruitment to the services during the great depression of the 1930's, the course was abandoned. And, it was not again till 1938, during Sir Jagadish Prasad's tenure as Member in charge, the course was revived at Dehra Dun and styled the "Superior Forest Course". Immediately after, the second World War intervened and again upset the apple cart. Many a plan of development had necessarily to be put in cold storage till happier times. We are all familiar with the turbulent events that followed, culminating in the achievement of the country's independence. And, the institution of a parallel course at Coimbatore in 1948 is to be suspended this year, mainly, it is announced, on account of a substantial fall in the recruitment for the Forestry Services. The ranger's course at Dehra Dun is fortunate in having enjoyed more continuity. Also, the Dehra Dun Ranger's College has been supplemented by a number of Provincial Forestry Schools designed to provide rangers for the provincial cadres. No Indian University offers forestry courses leading either to a Diploma or a Degree.

A feature of the training at Dehra Dun, specially of the "Superior" course, is its expensiveness. The cost to the student of this two-year "superior" course is of the order of Rs. 12,000. This is very high, compared either to the costs of training in many other countries

in the world (where standards of living are much higher than in India) or *vis-a-vis* the general level of income and cost of living here. In fact, it is doubtful if the technical training for any other profession in India costs more than forestry training. The facts that forestry training is intensely practical and that it involves extensive touring all over the country no doubt do contribute to the cost but do not account fully for the high bill. Whatever the reasons be, the expense has in effect shut out a great many otherwise promising students from Dehra Dun unless they happen to be Government or state scholars. This has tended to give Dehra Dun a flavour of exclusiveness which is not met with in many other leading European Forest educational institutions.

This, in brief, is the present position. And now that the country is free to set its own house in order to conform to its needs, its convenience and ideals, we are of opinion that the time is opportune to re-examine the whole question of forestry education in the country. Are the existing facilities sufficient—in quality and quantity? What are the advantages in having several levels of training—"superior", provincial and the like? Who should prescribe and ensure standards of training—Central Government, State Governments, Universities or *ad hoc* bodies? Is it necessary or even desirable that Forestry education should serve exclusively or primarily the needs of service recruitment? What role can the Universities play in Forest education and research? How best can Forest education help in fostering Forestry as a *profession*—the maintenance of its integrity, development and the promotion of an *esprit-de-corps* amongst its practitioners? Why cannot we develop the Indian centres with our resources in men and material and fine traditions of forestry into international centres for education in tropical forestry? Forest education and technique could well form important export items of the country. They may not earn much in foreign exchange but they can and will earn international good-will and rank high in prestige value.

This bald statement (by no means comprehensive) of the more important issues involved indicates the complexity and many-sidedness of the problem. They do not admit of categorical answers without much more detailed and

expert examination; nor could the answers be implemented without co-operative endeavour salted with high national purpose.

These decisions and their translation to action necessarily take time. Certain mental re-adjustments can well precede them. The Forestry Service in the country is no longer an exotic transplanted from outside the native soil and conditioned to suit the convenience of an alien people. And while we should thankfully remember the work of the foreign pioneers, there is no point in enshrining and perpetuating the elements of superiority and aloofness which were noticeable features of the earlier tradition. Artificial distinctions based on mere prerogative and privilege have to make room for natural leadership born of aptitude, knowledge and experience. And Forest education should recognise these needs and be designed to cater to them.

This does not imply any admission that Forestry education should forever be the handmaiden of service needs. On the contrary, there is a good case for introducing elementary forestry as one of the optional subjects in the science degree courses of our universities. Such an arrangement would benefit the student should he take up forestry or agriculture as a career; even otherwise, it would benefit him as a citizen by its intrinsic worth of scientific discipline and cultural value. (All those who study zoology in the university do not necessarily become entomologists nor does everyone who studies music sing on the stage.) It would widen the field of selection of the future professional forester and research worker. It would enable the universities to build up vigorous schools of forestry research. More than all, an intelligent appreciation of the role of forestry in the national economy would be widely disseminated in the fabric of the community. This is a very great gain. For, the formation of informed, responsive public opinion is essential, especially in a democratic set-up, for the practice of scientific forestry which often prescribes and insists on the subordination of temporary, sectional and immediate gains to the ultimate and permanent good of the community as a whole. It is not without significance that in some of the Scandinavian countries—amongst the most advanced in the world in forestry and with democratic forms of government—quite a number of students

study forestry not to make a living or profession of it but just for its cultural and prestige value—as, for example, a law degree is taken in England.

The question of training Indian foresters outside India is a cograte problem. While there can be no doubt of the advantages of carefully selected Indian students receiving post-graduate training in specialised courses outside the country, the sending of a raw recruit for a first degree in a foreign country is waste of money and can become less than useless. As already mentioned earlier, the British recruits to the Indian Forest Service were trained, for the most part, in British institutions where the teachers were mostly retired members of the Indian Forest Service itself. Whatever its other merits, the system did not tend to promote a catholicity of outlook. This has since changed and a welcome feature of Indian Forestry in recent times is the increasing number of men who go out to study at reputed centres outside Britain.

We must repeat and emphasise however, that the centre of education for Indian Forestry must be India itself. Forests cannot be exported and Indian forests can best and only be studied in India. We are only too aware that many a post-war development scheme in the country is stymied by almost insuperable practical difficulties whose impact is cooling down the first flush of enthusiasm and sobering the high expectations. At such a time, it is comforting to know that the development of forests and forestry education present a field wherein *all the basic requirements are to be found within the country itself*. There are no difficulties connected with heavy investment; import of equipment; purchase of patent rights; exchange quotas; procurement of trained personnel and the technical "know-how"; and the many other hurdles of most other development schemes wherein almost the only role India is called upon to play is to pay humbly and hopefully.

For Forestry Education, on the other hand, all that is required is a clear enunciation of the objectives to be aimed at, preparation of careful plans to achieve these, and their implementation according to a time-table which takes account of our resources in men and material. We commend that this be done soon—the sooner the better for our forests and for the country.

QUANTITATIVE RELATION BETWEEN YARN STRENGTH AND FIBRE PROPERTIES

K. R. SEN, D.Sc.

THE writer in 1938 gave¹ an equation for calculating the yarn strength from fibre properties as under :

$$S_L = A \frac{l \cdot p}{f \cdot c} (1 - E) \quad (I)$$

Here, S_L represents the single thread strength of a cotton yarn of count, c , obtained by using a test length, L . l denotes the mean fibre length, p , the mean fibre strength and f , the mean fibre mass per unit length. The quantity A is a numerical constant which depends on the definition of the count with respect to the units of measurement considered. E in this equation embodies the various effects brought into being by the conditions of the yarn structure. Experience shows that the resultant of these effects, which E expresses, whenever significant, is detrimental to the realisation of the full strength of the fibre aggregate in the yarn. The effect of the test length on the yarn strength is also covered mostly by the omnibus-term, E .

The Spencer-Smith equation for flax derived from statistical considerations, in 1947, takes the form—

$$Q_L = Q_0 \left[1 - \frac{\omega_n \cdot F(n) \cdot V_0}{100} \right] \quad (II)$$

Here, Q_L is the average quality number of a long specimen of yarn of length, L . Q_0 is the mean quality number of the "fracture zone" or the length within which the actual fracture is confined (Turner⁵). ω_n denotes the mean difference between the average and the minimum value of n terms selected at random from the appropriate normalised frequency distribution (Tippett⁶), $F(n)$ is a function depending upon the serial correlogram of the strength of the fracture zone; and V_0 is the percentage of variation of the strengths of the fracture zones.

The form of the Spencer-Smith equation being similar to the author's, it was considered worth while to publish the method by which the equation (I) was derived and also to scrutinise and compare the two equations.

(A) Derivation of Equation (I)

Equation (1) is built up from the following considerations:—

(i) *The strength of all fibres within the smallest specified or standard test length.* This standard length for cotton is considered to be the same as the average fibre length. We may represent the strength of the yarn of a length equal to the average fibre length by S_L .

(ii) *The increase in strength caused by (a) the binding effect of twist on fibres constituting the yarn; and (b) the frictional resistance offered by the mutual surfaces of contact opposing any slippage under tension.*

These positive effects of strength are physically known facts and may be together denoted by T .

(iii) *The decrease in strength, due to (a) possible non-clamping of some fibre-ends in the main region of fracture, a fact which is likely to permit easy displacement of such fibres under the applied tension; (b) the pre-existing tensile strain in some of the component fibres, the magnitude of which varies according to their distribution between the surface and the core of the yarn (these differences in magnitude occur as a result of the differences in the twist angle); as well as (c) the statistical effect of the longer actual test-length due to the presence of the thick and the thin places in the yarn.* These irregularities of yarn-structure are caused by the unequal relative displacement of the fibres along the length of the yarn during drafting, and constitute the most important source of reduction in yarn strength. The resultant negative effect on the strength of the yarn may be denoted by $-F$.

In addition to these principal factors there may yet be others which are either positive or negative in their effect on the yarn strength. Such minor factors are often local, arising out of the machine conditions and/or some peculiarities in the structure of the yarn or the constituent fibres. These are yet undefined, and their total effect, as far as experience goes, may be neglected for all practical purposes.

Now, to derive equation (I) in the simplest manner, let G represent the maximum strength of the yarn from fibre fracture only, when a test length equal to the average fibre length is used. It is common experience, and also a matter which can be theoretically understood, that the fracture of the fibres, which occurs, is not confined to one particular cross-section, but is distributed over various cross-sections within a length $\approx l$ or just $< l$. It cannot be

† It is the total aggregate strength such as would obtain on the breaking load of all the fibres concerned being realised.

greater than l^* . The harder the twist, the smaller is this length. It happens thus. A fibre must break at the weakest point; this point may, however, be situated anywhere within its length. So, the points of break of the fibres, broken by the application of the tensile stress, will be situated within a zone $\gg l$ at different distances from any particular cross-section, for the individual fibres concerned. Thus the breakage of the yarn will spread over a region of its length, instead of being confined to a point. But the spread of this region of break along the length of the yarn, will, of course, naturally depend on the frictional and other effects brought into play by the degree of applied twist. We can not, therefore, expect to arrive at the true aggregate strength of the fibres in a test length equal to the average fibre length by confining ourselves to a particular cross-section only, to the exclusion of all others involved in a yarn break. We must take into consideration for practical reasons, all the fibres, whole or part, such as lie within the length, l .

Now, from previous considerations, $S_l = G + T - F$; also F is very much bigger than T ; and $G > (F - T)$. This latter inequality is clearly proved by the fact that the resultant strength observed for a yarn is real and positive. Thus we may write,

$$S_l = G - (F - T).$$

If then we express $(F - T)$ in terms of G such that $F - T = e.G$, where e is a proper fraction depending on the structural characters of the yarn, we ultimately get,*

$$S_l = G(1 - e). \quad (\text{III})$$

In order to evaluate G , we must find a way to estimate the number of fibres which, on an average, lie within the length l of the yarn. To do this let L represent the actual test-length of the yarn in a yarn-break test. L is many times larger than l . Representing the total number of fibres which lie within the length, L , by N_L , the average number per unit length, may be taken as N_L/L . Let this quantity be

represented by N . In a test length equal to the average fibre length, l , the number of fibres, on an average, will then be practically equal to Nl . (As L is kept constant for all yarns, $N \propto N_L$.) On these considerations we may put,

$$G = Nlp$$

The mean value of N can, however, be obtained in this manner. The average mass per unit length of the yarn = $A \div c$, A and c being as defined earlier. The mean fibre mass per unit length being f (see *ante*), the average number of fibres per unit length of the yarn, or $N (= N_L/L)$, should be given by $A \div cf$. Therefore, $Nl = Al/cf$. So,

$$G = Nlp = A \frac{lp}{cf} \quad (\text{IV})$$

Thus we get the value of G in terms of the properties of the yarn and the component fibres. So, from equations (III) and (IV), we have for the yarn, having a test length equal to the average fibre length,

$$S_l = A \frac{lp}{f \cdot c} (1 - e).$$

Now, calling $c.S_l$ as Q_l or the "quality number" of the yarn, when the test length = l we may write,

$$Q_l = A \frac{lp}{f} (1 - e)$$

There is one point which requires to be considered here. For such a small test length as the average fibre length of cotton, the effect of the strength gradient should be extremely small for statistical reasons. It is in fact found to be practically insignificant.⁹ Also, as most of the fibres are likely to be clamped (*cf.* Sen & Nodder⁷) at both ends at this test length, the possibility of slip under tension significantly affecting the yarn strength is negligible. Further, the diameter of the normally twisted cotton yarn being small, and the number of twists per unit length fairly large, any difference in twist on fibres in the yarn must be small. The negative effect being thus greatly reduced, since however the effect of T must be practically unaffected, the value of $F - T$ must be regarded as negligible compared with G . In other words, $e = 0$. On these considerations,

$$Q_l = A \frac{lp}{f}$$

However, for an actual test length, L , which is many times longer than the average fibre length, the specific conditions reducing ' e ' to zero, do not exist. It is in fact found from experience that with the usual test length, L , the loss of strength due to the effect of yarn structure,

* As soon as one or more fibres at any point in the test length has broken, the remaining fibres about the point gets the share of the load which, therefore, increases rapidly per fibre as fibres break, precluding yarn-break anywhere outside the zone (*cf.* Turner). Use of the average fibre length, l , as the minimum test length for calculation of yarn strength therefore corresponds to the limiting "fracture zone". A significantly shorter length than l cannot also fulfil this condition.

which brings down the value of G , is considerable. So, for a test length = L , we may represent $F - T$ by $E \cdot G$ and get—

$$S_L = A \frac{lp}{fc} (1 - E),$$

which is the same as the equation (I). Representing S_L by the corresponding "quality number", Q_L , we may write—

$$Q_L = Q_1 (1 - E). \quad (V)$$

This reduces equation (I) to a form identical with that given by Spencer-Smith.

Value of E

There is a great deal of difficulty in evaluating E physically in terms of the fibre properties. It is so because of the general structural uncertainties involved in even such a yarn as may be regarded as the nearest approach to the ideal from practical considerations. This led the writer to fall back upon the then existing results of measurement of the properties of the fibre and the yarn and, with their help, to develop an arbitrary scheme, of E with reference to the gradations of count of yarn and the intrinsic strength of the fibre. The intrinsic strength, p/f , termed by some as tenacity, was shown by Balls³ to be a most important character governing spinning quality. It was found (Sen⁸) that the agreement between the observed yarn strength of cotton and the yarn strength calculated from equation (I) using the given arbitrary scale of E was reasonably close.

From a large number of data⁸ it was concluded that generally the observed and the calculated values based on the arbitrary scale of E differed by less than 5% of the former. A few cases with larger difference (~10%) were also noticed. The largest differences (~20%) were however found in the case of the binary mixtures of different cottons and may have been caused by lack of perfect homogeneity of the mixed product affecting the observed yarn strength.

¶ It is to be noted that while the symbol, z , has been used for use in case of a test length, L , equal to the average fibre length, for any actual test length, L , the symbol used is E . The length gradient of strength, for instance, is an important contributor to E , but has rather an insignificant effect on z . Considering the dimensions of the quantities which take part in equation (I), it appears that the factor E has the inverse dimension of length.

(B) Comparison of Equations for Flax and Cotton

Equation V derived above and Spencer-Smith's equation for flax (equation II) seem to possess the following common features—

- (i) Both the equations represent the relation between the count-strength product (quality number) of a yarn at a long test length and that of the same yarn at the shortest standard or assessable test length.
- (ii) Both the equations contain a reduction term for strength at the shortest standard test length. This expresses itself in the equation as deviation from unity, of the ratio :

$$\frac{\text{Count-strength product at the observed test length}}{\text{Count-strength product at the specified shortest test length}}$$

Thus in both cases, the count-strength product obtained at the shortest specified test length requires to be multiplied by a suitable proper fraction to obtain the count-strength product at a desired test length.

The principal point of difference between the two equations is that the basic test length is the average fibre length in the case of cotton, and the length of the fracture zone in the case of flax. This point may be discussed further.

The mean length of cotton fibre which can be easily spun varies from 0.5 inch to slightly over 2 inches. The maximum in the case of the Indian cottons, however, hardly exceeds a little over an inch. On the other hand, the mean filament length of flax is several times longer than the maximum length of cotton. Unlike therefore the case of cotton which possesses very short filaments, there is distinct possibility of occurrence of significant effect of a fibre strength gradient in the case of the long filaments of flax. This possibility precludes the use of the average length of flax as the shortest standard or assessable length. The same reasoning also applies to any other long textile fibre such as wool, jute, nettle, ramie, etc. Now, Spencer-Smith (*loc. cit.*) has pointed out that the mean length of the fracture zone of normally twisted flax yarn is about 0.5 inch. With this length used as the test length of flax yarn, the effect of the strength gradient of the yarn is undoubtedly obviated, the clamping of the fibres at both ends may also be assumed generally, and no complication due to the strength gradient of the fibre may be expected. Thus the principal,

advantages of using the average fibre length of cotton as the shortest standard test length, are obtained in the case of flax if the length of the fracture zone is adopted.

There is another point calling for attention, viz., the "difference" term which is E in equation (V), and

$$\left[\frac{\omega_n \cdot F(n) \cdot V_0}{100} \right]$$

in equation (II). In using the length of the fracture zone as the shortest test length, Spencer-Smith has pointed out that the relationship between the adjacent fracture zones arises from the fact that one flax fibre may spread over several fracture zones (apart from the question of any random variation imposed by the machinery). But when we use the average fibre length as in the case of cotton, i.e., when short fibre materials are under consideration, the effect of this factor should be insignificant. It is therefore regarded that $F(n)$ which is based on the above consideration in the case of flax (as well as of other long fibres) cannot persist as an important factor in the evaluation of the difference term for cotton and similar other short fibres. In other words, the strength-reducing quantity E for cotton should not be significantly influenced by the correlation of the adjacent small lengths as indicated by Spencer-Smith to be the case with flax.

It may be worth-while to explore both the physical and the statistical possibilities which govern the values of the slippage factor E .

(C) The Applicability of Equation (I) to Jute

With respect to equation (V), it may be pointed out that the author¹⁰ observed in the case of jute yarns a linear trend between the adopted measures corresponding to Q_L and Q_L , respectively. This indicates that for jute which is a long fibre, the effect of the "slippage factor", E , is not very important.

However, the possibility of wide variations in the measurements, particularly of p , in the case of jute filaments, and the fact that "fibre-length" of jute is, so to say, created by the processes involved in spinning, make the applicability of the equation to this fibre only of academic interest.

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8. Sen, K. R., *ibid.*
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FUEL RESEARCH INSTITUTE

THIRD in India's chain of eleven National Laboratories, the Fuel Research Institute at Digwadih (Dhanbad) in Bihar is due to be opened on April 22, 1950, by the President, Dr. Rajendra Prasad.

The Institute will conduct research on major problems concerning fuel—solid, liquid and gaseous—and will operate a physical and chemical survey of Indian coals, to provide a reliable assessment of the quality and quantity of the various coal resources of the country.

In addition to problems of fundamental and applied research, sampling and analysis of coal will be undertaken and pilot-plants are to be developed for various processes.

The Institution's work will be distributed among the following main divisions: Coal Survey and General Analysis; Carbonisation and by-products; Liquid fuel (including hydrogenation, synthetic fuels, petroleum and substitutes); Physics (including X-ray and

Spectroscopy); Gaseous Fuels (including gasification); Engineering (including preparation of coal for the market, coal-washing, boiler plant and combustion engineering).

The Director of the Institute is Dr. J. W. Whittaker, who will be working in consultation with Dr. S. S. Bhatnagar.

There will be six Regional Coal Survey Stations working under the Institute for the physical and chemical survey of coals and will be located at: the Raniganj coalfield, with a laboratory near Dishergarh; the Jharia field with its laboratory at the Central Institute at Digwadih, the Bokaro-Rangarh-Karandpur fields with a laboratory at Ranchi, the Eastern States coalfields (Vindhya Pradesh) with a laboratory at Umaria, Sagra Estate; the Madhya Pradesh (C.P.) coalfields, with a proposed laboratory at Kamptee near Nagpur, and the Assam coalfield with a proposed laboratory at Dibrugarh.

PILLOW STRUCTURES IN THE LAVAS OF DHARWAR AGE IN THE CHITALDRUG DISTRICT, MYSORE STATE

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THE author's attention was drawn recently by Raghunatha Rao* to a few outcrops in the Schist Belt of Chitaldrug District which, according to him, exhibited very well the orbicular structure.

The occurrence of these structures had been noticed earlier by Jayaram¹ who considered them to be a "curious spheroidal breccia". In his opinion, the dark hornblende rock has been intruded by the grey trap and the resultant hybrid rock presents these structures in which the rounded and angular hard fragments of grey traps are separated by thin flow bands of dark hornblende schist.

The following are some of the localities where these structures are clearly seen:—

(1) Δ 2326 near Maradihalli, about $1\frac{1}{2}$ miles due east of the 114th milestone on the Bangalore Chitaldrug road; (2) the northern flanks of Δ 2521, about 1 mile east of the 116th milestone on the Bangalore-Chitaldrug road; (3) Δ 2141 near Kallenhalli, just south of the 7th milestone on the Chitaldrug-Challakere road; (4) Δ 2234 south of the 9th mile on the Chitaldrug-Challakere road and about a mile WNW of Balenahalli and (5) the rise south of Δ 2389, and north-west of the 9th milestone on the Chitaldrug-Challakere road.

Of the above localities, these structures are best seen on Δ 2326, west of the village of Maradihalli. The photographs illustrating the present note are from this hillock.

In the author's opinion, these are undoubted pillow structures which have been preserved in fairly good condition, despite the age of these lavas.

The distance between the first and the last spot mentioned above is over eleven miles, and so this phenomenon is not of very local occurrence. The genetic relationship of pillow lavas to the physical conditions under which the rocks consolidated has rendered these structures of great importance in working out the structure and stratigraphy of lava flows. Detailed geological mapping in this region would undoubtedly throw further light on whether these different outcrops belong to a single flow or to different flows; in either case, this discovery should afford some assistance in working out the stratigraphical succession in this part of the Chitaldrug Schist Belt.

The pillows are usually ellipsoidal or irregular, and rarely spherical in shape. They vary in size from about eight inches to two feet (*vide* Fig. 1). Many of the pillows are



FIG. 1. From hillock west of Maradihalli. The well-defined "skin" and radiating joints of the pillows are clearly seen. The pillow below the handle of the hammer has pushed itself between two other pillows suggesting its plastic nature when formed.



FIG. 2. From hillock west of Maradihalli. Weathered block of pillow lava. Note the fissile skin, the circular and elongated vesicles, radial jointing, and the indentation caused by neighbouring pillows. The pillows are sometimes flattened or indented by contact with neighbouring ellipsoids. The pillows are sometimes connected with one another, and in rare cases appear to have formed as a bud from a larger mass.

* Geologist, Mysore Geological Department.

Each pillow has a distinct skin which is about an inch in thickness; it is usually non-vesicular and often exhibits a banded structure parallel to the outer surface. The interior of the pillow is vesicular. The vesicles have a roughly concentric arrangement. They increase in size from the border to the centre of the pillows. Usually, they are more numerous in the outermost layers, and decrease in number towards the interior. In many cases, the vesicles nearer the border have an elongated shape like pipe amygdales, their longer axes being disposed in a radial manner. The vesicles are filled in mainly with epidote and so appear dark green in colour.

The pillows are solid to the core and sometimes exhibit concentric bands. Many possess an imperfect radial jointing; gypsum has crystallised often on these joint faces.

The structure of these pillows is very clearly exhibited in weathered outcrops (*vide* Fig. 2). In such cases, the interspaces are usually geuged out and so the pillows are found piled one above the other. The joints and vesicles are also seen to better advantage.

In a previous note it was pointed out that the trap rocks occurring near Chitaldrug show the chemical and petrographical features characteristic of spilitic lavas.² The present discovery, therefore, of these pillow structures in this region confirms this conclusion, as spilitic rocks in many parts of the world are subaqueous extrusions.

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ENDEAVOUR PRIZES

As a contribution to the meeting of the British Association for the Advancement of Science to be held at Birmingham in September 1950, Imperial Chemical Industries Limited, publishers of the quarterly scientific review *Endeavour*, have offered the sum of 85 guineas to be awarded as prizes for essays submitted on a scientific subject. As the primary purpose of these awards is to stimulate younger scientists to take an interest in the work of the British Association and to raise the literary standard of scientific writing, the competition is restricted to those who are not more than 25 years of age on 25th June, 1950. Three prizes will be awarded: a first Prize of 50 guineas, a second Prize of 25 guineas, and a third Prize of 10 guineas. The subjects for the essays are as follows:

1. Modern Techniques in Astrophysics.
2. Phenomena at Low Temperatures.
3. The Literature of Science.
4. Radioactive Tracers.
5. Metallic Corrosion.
6. Macro-molecules.
7. The History and Significance of Common Salt.
8. The Scientific Method.
9. The Mechanism of Heredity.
10. The Biological Significance of Trace Elements.
11. Industrial Applications of Biology.
12. The Earth's Crust.

The essays, which must be in English and typewritten, should not exceed 4000 words in length, and only one entry is permitted from each competitor.

All entries should be addressed to: The

Assistant Secretary, British Association for the Advancement of the Science, Burlington House, Piccadilly, London, W.1 and the envelope should be clearly marked 'Endeavour Prize essay'. The latest date for receipt of entries is 26th June 1950. The essays will be judged by the editors of *Endeavour* in consultation with representatives of the British Association, and the prizes will be awarded during the meeting of the British Association in Birmingham in September 1950. The judges' decision is final, and they reserve the right to withhold all or any of the prizes should no entries of sufficient merit be received.

The essays should be submitted without signature. The competitor's full name and address and age should be disclosed in a sealed covering letter attached to the essay and addressed to the Assistant Secretary of the British Association, who will acknowledge all entries. The names will not be disclosed to the judges until after the prize-winning essays have been selected.

In judging the results, special attention will be paid to the way in which the subject is approached, and great importance will be attached to literary style. The competitor's age will also be taken into account. The essay winning the first prize will be published in *Advancement of Science* journal of the British Association.

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MULTIVARIATE STATISTICAL DISTRIBUTIONS AND ECONOMIC MACRODYNAMICS

THE general static equilibrium theory of Walras states that in a given stationary population, the tastes of individuals, distribution of the means of production, technical knowledge and the conditions of equilibrium determine the quantities produced and consumed, as well as their prices and the incomes of the individuals. We say that the structure of an economy is determined by the Walrasian system of equations when

$$\sum_{s=1}^n a_{rs} x_s = 0, r = 1, 2, 3, \dots, n \quad (I)$$

But it is more realistic to assume that the variables in the economy are given by the system of equations,

$$\sum_{s=1}^n a_r x_s = \eta_r, r = 1, 2, 3, \dots, n \quad (II)$$

where the η 's are random components distributed normally with zero means. Equation (II) defines the economic variables as components of a multivariate normal distribution with the means given by (I).

To test whether there is a structural change in the economy between two given ten year periods, collect observations at various time points in the two periods which can be taken as independent. Calculate the means for the two periods and the combined dispersion matrix. Now the D^2 -statistic of Mahalanobis gives a convenient measure of the structural change in the economy between the two periods. A measure of the intra-structural movement is provided by Wishart's distribution.

This analysis of the changes in the macro-economic system brings dynamic economics into a line with the analysis of the motion of a system of particles, *viz.*, motion of the centre of gravity and motion about the centre of gravity.

An elaboration of the theory, with illustrations from Indian economic data will soon follow.

Department of Statistics,
University of Bombay,
November 29, 1949.

K. S. RAO.

ON THE COOLING CORRECTION IN CALORIMETRY

AN idea of the relative contributions of radiation and convection to the heat losses or gains in the laboratory experiments on calorimetry (in which a copper calorimeter is hung inside a bigger copper vessel by means of threads) can be obtained in the following way. For small differences of temperature, the rate of heat loss (which includes radiation and convection) is given by Newton's Law of Cooling. Expressed in symbols, this law is:

$$\frac{dQ}{dt} = K (\theta - \theta_0),$$

where 'dQ' is the amount of heat lost in the interval 'dt', 'K' a constant depending upon the nature and extent of the cooling body, the nature and pressure of surrounding gas, the shape, size and nature of any other vessel which surrounds the cooling body. θ & θ_0 are the temperatures of the body & surrounding medium respectively. If 'm' is the mass of the cooling body, 's' its sp. heat, and ' $\delta\theta$ ' the fall in temperature in interval ' δt ' in which it has lost heat by an amount 'dQ'

$$dQ = -ms \delta\theta$$

$$= K (\theta - \theta_0) \delta t \quad (1)$$

$$\text{or } -\frac{\delta\theta}{\delta t} \cdot \frac{ms}{(\theta - \theta_0)} = K \quad (2)$$

Thus if 'K' is calculated by inserting the value of the rate of fall of temperature $-\frac{\delta\theta}{\delta t}$,

at a certain temperature θ in 2, the heat loss 'dQ' in an interval ' δt ' can be calculated from (1) and if the superficial area of the cooling body be known, the rate of heat loss per unit area is also easily calculated. This gives the total heat loss. If the body be assumed to be behaving as a black body, the rate of heat loss due to radiation per unit area from it can be calculated by the Stefan-Boltzmann Law. Thus if its temperature be $T^\circ\text{A}$ & $T^\circ\text{O}$ be the temperature of the surroundings, this is given by, $\sigma(T^4 - T_s^4)$

where ' σ ' is Stefan's constant. The assumption that the body is behaving like a black body is highly artificial but it gives an upper limit of the heat loss due to radiation. Comparing this value with the one which gives the total heat loss, as calculated above, the relative contribution of radiation is computed. For a small difference of temperature of 5°C . between the body and surroundings, the results of an experiment on the above lines show that the contribution of radiation is 75%. Thus convection is certainly responsible for 25% of heat loss and obviously more than 25%, as the body is not a black body. This dispels the confusion sometimes prevailing that it is radiation which is the all important factor.

Science College, MANORANJAN PRASAD GUPTA.
Patna,
March 19, 1950.

INTENSITY OF RAMAN LINES IN BARYTES

THE temperature variations of the intensities of the Stokes and anti-Stokes Raman lines in barytes have been investigated by the author. The method of intensity measurements adopted has been described in a previous communication.¹ All the Stokes lines, lattice as well as internal, were found to decrease in intensity with rise of temperature while the anti-Stokes line corresponding to 73.6 cm^{-1} , 462 cm^{-1} , and 988 cm^{-1} , showed a conspicuous increase with the rise of temperature. The relative intensities for the 988 line are listed in Table I and the S/A.S. ratio for the 73.6 cm^{-1} line in Table II.

TABLE I

Temperature	Stokes 988 cm^{-1}		Temperature	Anti-Stokes 988 cm^{-1}	
	Observed	Calculated		Observed	Calculated
300°K .	1	1	300°	1	1
427°	.84	1.03	363	1.3	2.3
517°	.79	1.06	427	2.2	4.2
525°	.7	1.09			

TABLE II

Ratio S/ A.S. 73.6 cm^{-1} Raman line

Temperature	$e \frac{h\nu_s}{k\tau}$	$\left(\frac{\nu - \nu_s}{\nu + \nu_s}\right)^4$	$e \frac{h\nu_s}{k\tau}$	Observed value
300°K .	1.42	1.40		1.35
427	1.28	1.26		1.25
517	1.23	1.21		1.20
595	1.19	1.18		1.15

There is a decrease in intensity of the Stokes lines instead of the theoretically² expected increase and the anti-Stokes increases with rise of temperature but to a smaller extent. In the case of CCl_4 such a discrepancy has been explained as being due to the anharmonicity introduced by centrifugal force due to rotation.³ In the other cases that have been studied it has been attributed to the expansion of the series

polarizability α as $\alpha_0 + \sum \left(\frac{\partial \alpha}{\partial q} \right)_0 q + \dots$ by Taylor being not valid for large values of q .⁴ This latter explanation is not correct as the Taylor series expansion must be true though there is a dependency of $\left(\frac{\partial \alpha}{\partial q} \right)_0$ on temperature as a result of anharmonicity. Even when an attempt is made to take into account this anharmonicity by using the wavefunction obtained from the Morse function instead of that of a simple harmonic oscillator, the intensity of the Stokes line should only increase though to a different extent, with rise of temperature. So in an actual case, if it is assumed that the scattering from molecules in the higher states is not much more than those in the lower states and that transitions involved in the formation of the Stokes line are less probable than those in the case of the anti-Stokes line, we can understand the observed decrease in intensity of the Stokes line with the rise of temperature.

Physics Department,
Indian Institute of Sci., P. S. NARAYANAN.
Bangalore-3,
March 22, 1950.

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ABSORPTION SPECTRA OF TELLURIDES OF ANTIMONY AND BISMUTH

THE author has studied the absorption spectra of SbTe and BiTe molecules in the vapour state at high temperatures using a graphite electric furnace. None of these molecules has been studied previously, either in emission or in absorption. Several band systems have been observed and studied in detail. The band-heads have been measured and the band

systems analysed. The following table gives the various band systems observed and the values of the molecular constants deduced from the vibrational analysis of these systems.

TABLE I

Molecule System Region in A.U.	Molecular constants					
	ν_e	ω_e''	$\omega_e''\chi_e''$	ω_e'	$\omega_e'\chi_e'$	$\omega_e'\chi_e'$
SbTe I 2383-2260	43553	234.4	0.20	314.50	0.48	
BiTe I 2942-2814	..	208.5	0.52	..	..
BiTe II 2454-2382	..	208.5	0.52	..	..
BiTe III 2390-2315	42870	208.5	0.52	164.40	0.42	
BiTe IV 2374-2279	43116	208.5	0.52	263.00	0.96	
BiTe V 2276-2200	..	208.5	0.52	..	..

For all these band systems analysed Condon parabola have been drawn. These, in general, are narrow as would be expected from the nearness of ω_e'' and ω_e' values.

In some of these measurements the absorption bands of the metals Sb_2 or Bi_2 , also appeared prominently. These spectra, however, are easily identified since they are well known from the detailed studies of Nakamura and Shidie, Almy and Sparks. Fortunately they do not overlap with the spectra of the SbTe or BiTe molecule and hence do not interfere with the present measurements.

The author wishes to express his thanks to Sir K. S. Krishnan, F.R.S. under whose supervision the work was done.

Physics Department,
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March 13, 1950.

C. B. SHARMA.

ABSORPTION SPECTRA OF ANTIMONY AND BISMUTH SELINIDES

THE absorption spectra of SbSe and BiSe have been studied in the vapour state at high temperatures using a graphite electric furnace. None of these molecules has been studied previously either in emission or in absorption. Several band systems have been observed and studied in detail by the author. The band-heads have been measured and the band systems analysed. The following table gives the various band systems observed and the value of the molecular constants deduced from the vibrational analysis of these systems.

For all the band systems analysed Condon parabola have been drawn. These, in general, are narrow as could be expected from the nearness of ω_e'' and ω_e' values.

TABLE I

Molecule	System	Region in A.U.	Molecular Constants				
			ν_c	ω_c''	$\omega_c''x_c''$	ω_c'	$\omega_c'x_c'$
SbSe	I	3685-3289	28965.0	326.1	1.04	221.80	1.00
SbSe	II	2870-2620	36041.0	326.1	1.04	418.90	0.48
SbSe	III	2456-2360	..	326.1	1.04	..	..
SbSe	IV	2335-2222	43756.0	326.1	1.04	365.74	0.76
BiSe	I	2900-2700	35617.5	264.7	0.40	304.00	2.00
BiSe	II	2350-2200	44425.0	264.7	0.40	316.00	2.00

In some of these measurements the absorption bands of the metals Sb_2 or Bi_2 also appeared prominently. These spectra, however, are easily identified since they are well-known from the detailed studies of Nakamura and Shidie, Almy and Sparks. Fortunately they do not overlap with the spectra of SbSe and BiSe and hence do not interfere with the present measurement.

The author wishes to express his thanks to Sir K. S. Krishnan, F.R.S., under whose supervision the work was done.

Physics Dept.,
Lucknow University,
February 28, 1950.

C. B. SHARMA.

A THEORETICAL EXPLANATION OF THE JOSHI-EFFECT

THE Joshi-Effect may be summed up as follows: A gas is contained between the plates of a condenser across which a low frequency alternating p.d. is applied. The current passing through the gas is recorded. If now the gas is irradiated with continuous visible light a fall in the current conducted through the gas amounting to 50-80% or even 90-95% is recorded. This is called the Negative Joshi-Effect. A few cases have been found in which the current is found to increase instead of decreasing. This is called the Positive Joshi-Effect.

First we shall take up the Negative Joshi-Effect. The underlying idea of the theory developed here is that: (1) when the gas is not exposed to light, the ions responsible for conduction of current possess a certain mobility, (2) when the gas is exposed to light, ions and/or neutral particles become excited due to absorption of light, and their outermost electron occupies a higher orbit, (3) occupation of a higher orbit by the electrons means a large increase in diameter of the ions and/or neutral particles and therefore a still large decrease in their mean free-path, (4) this decrease in mean free-path leads to a corresponding decrease in the mobility of the ions, and hence also a decrease in the current.

Consider a simple hydrogen-like ion having a positive core of charge Ze which influences the electron in the outermost shell of the ion. The radius a of the Bohr orbit of the electron will be given by

$$a = \frac{h^2 n^2}{4\pi^2 m e^2 Z} \quad (1)$$

where m = mass of electron, e = the charge of the electron, h = the Planck's constant and n is the quantum number of the orbit.* Now λ , the mean free-path of a particle, is given by

$$\lambda = \frac{1}{\sqrt{2} n_0 \sigma^2} \quad (2)$$

where n = the number of particles per unit volume and σ = the diameter of the particle = $2a$. Therefore on substituting† from (1) into (2)

$$\lambda = \frac{2\sqrt{2} \pi^3 m^2 e^4 Z^2}{n_0 h^4} \cdot \frac{1}{n^4} = K/n^4, \text{ where } K \text{ is a constant} \quad (3)$$

Now mobility of an ion is given by (see Crowther)‡

$$\text{mobility} = \frac{1}{2} \cdot \frac{e}{m} \cdot \frac{\lambda}{V} \quad (4)$$

where V = the velocity of thermal agitation, and, is therefore a constant at the room temperature.

From (3) and (4)

$$\text{mobility} = \frac{1}{2} \cdot \frac{e}{m} \cdot \frac{K}{V} \cdot \frac{1}{n^4} = C/n^4 \quad (5)$$

where C = a constant at a constant temperature. Current passing through the gas is proportional to the mobility. Hence

Current = a/n^4 , where a is a constant... (6) Thus we see that the current varies inversely as the fourth power of the quantum number of the orbit the outermost electron occupies.

Thus if the electron goes from first orbit to second orbit the current due to the ion will be reduced in the ratio of 16:1; if it goes from second orbit to third the current will be reduced in the ratio of 81:16, i.e., 5:1. This explains the Negative Joshi-Effect.

Positive Joshi-Effect: If due to the action of the alternating p.d. the ion is already in an excited state, such that transitions to the lower states are forbidden, then on exposure to light it may pass over to a higher state from which transitions to the lower states are allowed, and hence the ion may go to the lower states. A little consideration will show that on the whole in this process there will be an increase in current. For example, suppose that the ion is already in the state 2 and transition to state 1 is forbidden, and it passes to state 3 on exposure to light and then returns to state 1. Equation (6) gives the initial, intermediate and final currents as $\frac{\alpha}{16}$, $\frac{\alpha}{81}$ and $\frac{\alpha}{1}$. The mean of the last

two may be roughly considered to be the effective current on exposing to light. This is about $\frac{\alpha}{2}$ and is evidently greater than the initial current $\frac{\alpha}{16}$. Thus, under suitable conditions Positive Joshi-Effect may be observed for some substances.

With the same substance under different conditions (e.g., variations in frequency, the value of the alternating p.d. and the pressure of the gas used) both Positive and Negative Joshi-Effect may be observed, when there is a high probability for the ions to pass to a higher state from which transition to lower states is forbidden.

The author is thankful to Dr. K. Majumdar for valuable discussions.

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Allahabad University,
December 20, 1949.

* For more complicated atoms and for molecules this formula has to be modified, but it is evident that the size of the ion will increase with z .

† Here the effect of charge and the difference in the diameter of other particles has been neglected, the theory outlined being only rough.

‡ J. A. Crowther, *Ions, Electrons and Ionizing Radiations*; Seventh Edition, pp. 27-28.

DIELECTRIC CONSTANTS AND ELASTIC MODULI OF UNIAXIAL CRYSTALS

WHILE trying to account for the higher value of the dielectric constant parallel to the optic axis than in the perpendicular direction of alumina (an optically negative crystal), an interesting similarity between dielectric constants and elastic moduli of uniaxial crystals

disclosed itself. The constants of different crystals are given in the table.

Crystal	Dielectric constants		Elastic moduli		Investigator
	K_{11}	K_1	$\epsilon_{11} \times 10^{13}$	$\epsilon_{33} \times 10^{13}$	
Calcite	.. 8.2	8.7	11.0	17.3	Bhimasenachar
Apatite	.. 8.6	10.2	6.1	10.88	"
Beryl	.. 6.8	7.6	4.42	4.70	Voigt ²
Tourmaline (transparent)	6.0	7.4	3.98	6.24	"
Alumina	.. 11.8	9.5	2.84	2.21	Sundara Rao ³
Quartz	.. 4.6	4.45	13.0	9.90	Voigt ²

(The dielectric constants are those determined by the author.)

It can be seen from the Table that the dielectric constant is higher in the direction in which the modulus giving the contraction is smaller. Wooster⁴ pointed out that linear compressibility in a direction parallel to the plane of the carbonate or nitrate ions of calcite or sodium nitrate is smaller because of the greater binding strength in that plane. This is indicative of close packing of ions and hence the dielectric constant can be expected to be higher for any direction in that plane. It is seen that, in all other uniaxial crystals as well for which elastic and dielectric data is available, the direction of higher dielectric constant coincides with the direction of smaller modulus of elasticity or of greater binding strength. Thus the higher dielectric constant of alumina in the parallel direction is in conformity with the observed smaller modulus of contraction in that direction. It is reported⁵ that magnesium carbonate shows the same anomaly of having a higher dielectric constant in the direction for which the refractive index is lower and it will be interesting to examine its dielectric constants in relation to the elastic moduli. But unfortunately data on the elastic constants of magnesium carbonate are not available.

Physics Dept., D. A. A. S. NARAYANA RAO.
Andhra University,
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March 14, 1950.

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PECULIARITIES IN THE HORIZONTAL WIND FLOW AT THE VIZAG AIRFIELD

CIVIL pilots have often reported to the senior author, that they experience vigorous bumpiness in the neighbourhood of the hilly approaches to the Vizagapatam airfield (Fig. 1),

levels, as illustrated by the typical height-velocity curves reproduced in Fig. 2. This peculiarity cannot be due to non-uniformity in the rate of vertical ascent of the balloon, as this rate is a function of the buoyancy of the balloon due to density contrast.

The ratio of the minimum wind velocity

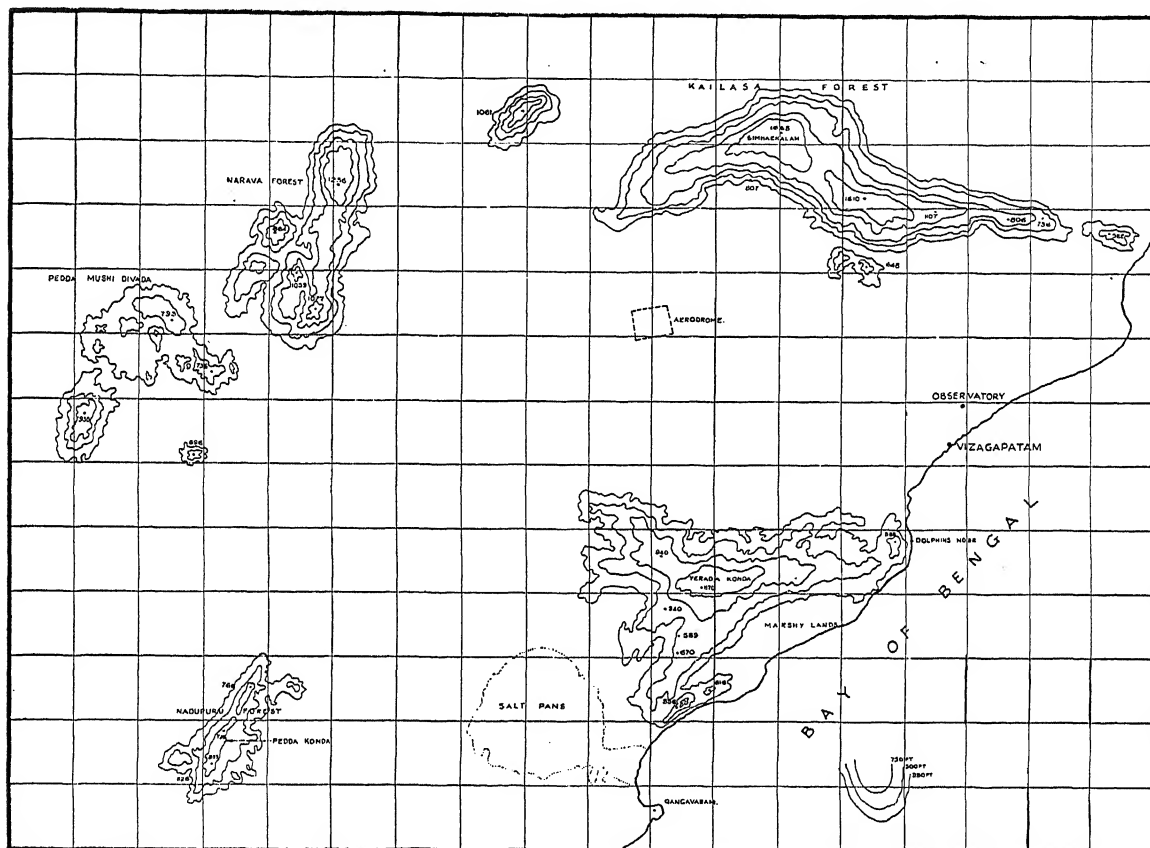


FIG. 1. Topographic Map of the Vizagapatam Airfield.

while landing and taking off. A scrutiny of the pilot balloon working sheets at Vizag on such days revealed a consistently unusual distribution of the wind velocity in the lower levels of the atmosphere. It was therefore of interest to investigate the influence of the orographic features at Vizagapatam on the upper winds in the lower levels of the atmosphere.

As the transitional month of October affords winds from all points of the compass, the data of 73 pilot balloon ascents in October 1949 at the Vizag airfield were studied. The anomaly in the velocity distribution was in the shape of a sudden dip in the velocity curve in the lower

reached to that just before its fall has been worked out as a percentage on each of the 73 occasions studied. In Table I are given the principal results of this investigation on occasions when the wind blew from the airfield towards the surrounding hills and plains.

The data showed that when the wind blew from the airfield towards Simhachalam and Yerradakonda there were respectively 97% and 88% of occasions of sizable velocity reduction of more than 20%. Winds blowing into the south-west sector, which is practically plain show a velocity drop only on 2 out of 13 occasions. On one of these, the fall was only by 29%; on the other, the balloon may have got

TABLE I

Wind sector from airfield	Towards	No. of occasions of velocity reduction			
		Less than 20%		More than 20%	
155-260°	Simhachalam	1	3%	30	97%
261-313°	Bay of Bengal	1	25%	3	75%
314-024°	Yeradakonda	1	12%	7	88%
025-076°	SW plains	13	86%	2	14%
077-123°	Narava	4	33%	8	67%
124-154°	NW plains	2	67%	1	33%

entangled in some perturbation in the wind field not traceable to orography. Three of the 4 occasions of the wind blowing from the airfield towards the Bay of Bengal were of sensible velocity fall. The wind directions in these 3 cases lie in the close proximity of the eastern ends of Simhachalam and Yeradakonda. Extension of frictional effects near these hills towards the Bay appears to be responsible for the origin of these anomalies. It may therefore be inferred that vigorous turbulence is generated in the neighbourhood of the principal hill ranges at the Vizag airfield by winds blowing towards them.

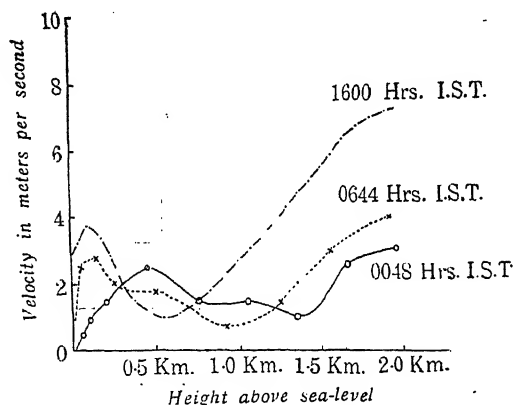


FIG. 2. Typical curves of the velocity distribution in the lower levels of the atmosphere on 22-10-1949.

An examination of the data of the winds blowing from across the hills and valleys towards the airfield showed that on 86% of the occasions of the winds from Simhachalam blowing towards the Yeradakonda across the airfield and 91% of the occasions of the winds from Yeradakonda blowing across the airfield towards Simhachalam there was considerable velocity dip. Again, 86% of the cases of the winds from the sector 026-075°, i.e., from Simhachalam across the airfield into the SW

plains were of negligible or no velocity fall. The frictional effects on the leeward side of these hills do not thus appear to extend up to the airfield. The winds from the SW plains, Narava and the NW plains carry the released balloon into the windward eddies of the principal hill ranges and it was found that on 96 to 100% of these occasions the velocity curve registered a steep fall in the lower levels.

A similar investigation carried out in regard to the pilot balloon data of the Maharanipetta Observatory near the coast at Vizag led to very similar results. Details will be published elsewhere.

Meteorological Office.

St. Thomas' Mount, D. VENKATESWARA RAO.
Madras,

July 25, 1940,

and

Met. Observatory, K. RAGHAVAN.
Civil Aerodrome,
Coimbatore.

SUCTION AND COMPRESSION BY LUNGS

THE action of human lungs in sucking in or forcing out air can be very well compared with that of an ordinary air pump and the usual formula, for the density or pressure of air in the receiver of an air pump, after a certain number of strokes of the piston, should be applicable in the case of the lungs also. To test this point, the following simple experiment was carried out in this Laboratory.

A long narrow glass tube is fixed vertically into a large trough of water. its upper end being connected by a thick rubber tubing to a small piece of a vertical glass tube L provided with a stopcock N and passing through a hard rubber cork into a large flask S.

A similar piece of another vertical glass tube M also passes through the rubber cork and communicates with the air in the flask S. The outer end of the tube M is connected to a rubber tube K provided with a pinch cock C. Keeping the cocks C and N open, air is sucked in by mouth through K from the flask S. This causes water to rise from the trough A upto a certain height h_1 in the tube T. As soon as one complete suck is over, the cocks N and C are closed so that the water level h_1 reached during the first suck is maintained constant and can be accurately determined. For the next operation, after applying the mouth to the outer end of the tube K, the cock C is opened and air is sucked in

from S, simultaneously opening the stop cock N. This causes the water to rise to a higher level h_2 in the tube T. This level h_2 reached during the second suck and maintained constant when the cocks N and C are closed, is again noted. This process is then repeated several times until no appreciable rise of water is caused in the tube T by any further sucking of air from S. The water levels $h_1, h_2, \dots, h_r, \dots, h_\infty$ corresponding to the serial number (r) ($r=1, 2, \dots, \infty$) of the air sucks are carefully noted, h_∞ denoting the level reached at the end of the last suck.

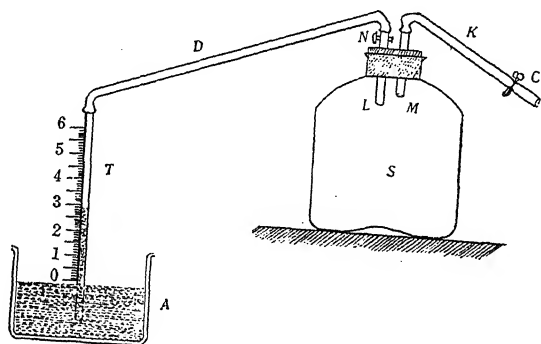
In the analogous case of an air pump, if V is the volume of the vessel (receiver) from which air is being pumped out and if the volume of the barrel varies from u to v ($u > v$), it can be easily shown that under isothermal conditions, the pressure p_r in the vessel after r complete strokes of the piston is given by:—

$$p_r = P - \left(\frac{V}{V+u} \right)^r (P-\pi) \quad (1)$$

where π is the atmospheric pressure and $P(=\pi v/u)$ is the lowest pressure attainable with the pump. We may put $P=p_\infty$. Now during any particular experiment of this type ($\pi-p_\infty$), where ($p_\infty=\pi-h_\infty$), remains constant and for the person doing the experiment, ($V/V+u$) is also constant. Hence (1) can be expressed as:

$$\log(h_\infty - h_r) = kr + k' \quad (2)$$

where k and k' are constants and $p_r = (\pi - h_r)$. It is found that in all cases, the graph of $\log(h_\infty - h_r)$ against r comes out to be a straight line.



By a slight modification of the above experiment, lungs were used to compress air in the big flask and the consequent rise of water in a long glass tube fixed in a smaller flask of water, was noted for different compressions. Results, similar to those of the first experiment,

case also, indicating the physical similarity between lungs and air pumps. Details of these experiments will shortly be published elsewhere.

Our thanks are due to Dr. D. S. Kothari, Scientific Adviser to the Ministry of Defence, New Delhi, for suggesting this problem.

Physics Department,
M. S. University of Baroda,
January, 31, 1950.

D. V. GOGATE
G. Z. SHAH.

DIELECTRIC CONSTANTS OF ALUMINA

THE author¹ previously reported the dielectric constants parallel and perpendicular to the optic axis of naturally occurring opaque corundum crystals. It was found that the parallel value was greater than the perpendicular value. This observation is not in agreement with that of Fellingner² and is also unusual as generally for uniaxial crystals the dielectric constant is higher in the direction in which the refractive index is higher. So to confirm those values, a transparent variety of the same crystal has now been studied. Sections from an artificially grown, perfectly transparent alumina crystal are used and the dielectric constants are determined by the liquid-mixture method³ at a frequency of 1.6 megacycles. The following values are obtained.

$$K_{II}=11.8 \quad \text{and} \quad K_{\perp}=9.5$$

K_{II} for the synthetic crystal is somewhat larger than the corresponding value for the natural opaque crystal, whereas K_{\perp} is nearly the same. Fellingner² reported $K_{II}=11.03$ and $K_{\perp}=12.80$ for synthetic sapphire and his values are not supported by the author's observations.

The author wishes to express his thanks to Prof. R. S. Krishnan for the kind loan of the crystal sections.

Dept. of Physics, D. A. A. S. NARAYANA RAO.
Andhra University,

Waltair,

March, 14, 1950.

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ON THE CONSTRUCTION OF METAL G.M. COUNTERS*

THE present note describes the constructional details and characteristics of Metal G.M.

* (The work was done in the Delhi X-ray

Counters (Fig. 1) so commonly used in Cosmic Ray and Nuclear Physics Research.

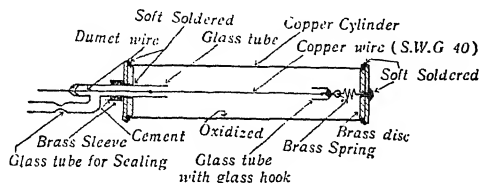


FIG. 1. Showing a Complete Metal Counter.

A seamless copper tube of about .5 mm. thick is closed at the ends by means of $\frac{1}{8}$ inch thick brass discs with holes of suitable diameter at the centre of each. Before assembling the counter the inside of the tube is well polished and cleaned properly with nitric acid. The cylinder and the end discs are thoroughly degassed at about 400°C for 2-3 hours, after which the cylinder is uniformly oxidized by heating it over a flame. An ordinary glass tube of about 5 mm. diameter and 1 mm. wall thickness (though it is not critical) is taken and a band of silver fused on it. This is done by putting some AgCl at the desired portion and heating it gently in a blow-pipe flame till a light layer of silver fused into the glass tube is obtained. A thin layer of copper is then deposited over the silver by ordinary electroplating. (Both chemical silvering and graphite layers have a tendency to peel off in flakes and should not be used. The above process, however, gives a very hard sticking layer). The tube is soldered to the brass disc at the plated portion by applying ordinary solder and it is found that it is as easy to solder this glass tube to brass disc as it is to solder two metal pieces. A small piece of dumet wire is sealed at one end of the glass tube to which is joined a side tube for filling the counter and sealing. One end of the central wire (copper, S.W.G. 40) is connected to the dumet lead and the other end is similarly connected and a brass spring attached to a glass hook placed as shown. The glass tubes also serve as sleeves and shield the ends which thus eliminate the possibility of local high fields. The two end discs are then soldered in position. A small space round the glass tube is filled with a cement (MgO + sodium silicate) which gives an additional strength to the glass-metal soldered joint. Finally the counter is washed with alcohol to remove any contaminations and a good coat of lacquer applied on the whole of the outer surface to remove any possible diffusion leak. It is then filled with commercial argon (8.5 cm.) and alcohol (100% pure) 1.5 cm. to a total pressure of 10 cm. of Hg. and

sealed. Fig. 2 gives the counting rate-voltage curve of a typical counter. The tube shows a considerably long plateau (525 volts) with small plateau slope (.04% per volt).

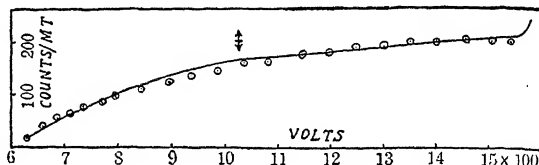


FIG. 2. Plateau curve for the Metal Counter. Arrow indicates the extent of the error in counts.

Due to its better qualities, ease of construction and low cost it is felt that the details will be of some help to workers in this field.

The author is grateful to Dr. P. L. Kapur, Reader in Physics, Delhi University, Delhi, for providing facilities for this work and for his interest throughout its progress; and to Mr. S. K. Suri, M.Sc., of the N.P.L. for helping in the initial stages of the work.

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OM PRAKASH.

POTASH-FIXING CAPACITY OF ALLUVIAL SOILS

HAUSER¹ found that Dutch soils containing mica minerals possess the greatest potash-fixing capacity. Seatz and Winters⁵ got similar results with micaceous soils. They suggested that the exchangeable potash remained in equilibrium with potassic soil minerals and that when the degree of potash saturation of the colloids is altered by manuring and cropping, it tends to be fixed or released respectively. The potash-fixing capacity of micaceous soils found here by Pathak, Mukerji and Shrikhande⁴ was determined to test the truth of Hauser's observations.

Potash-fixing capacity of manured and unmanured soils as affected by continuous cropping was studied, and a few important data are given below.

Apprehending that organic matter may interfere in the process of potash-fixation (cf. Joffe and Levine *et al.*) it was destroyed in these soils by hydrogen peroxide treatment. The hydrogen peroxide treated soil was found to be invariably greater in potash-fixing capacity in both the manured and unmanured samples, than the original soil,

Potash-fixing capacity of alluvial soils at different depths in both manured and unmanured plots

	0-6" mgm. %	6"-1' mgm. %	1'-2' mgm. %	Mean mgm. %	0-6" mgm. %	6"-1' mgm. %	1'-2' mgm. %	Mean mgm. %
	MANURED				UNMANURED			
Soil ..	1.27	1.66	3.43	2.12	2.31	1.64	2.85	2.27
H ₂ O ₂ treated Soil ..	2.09	2.24	3.82	3.05	2.96	2.06	3.08	2.70
Depression in K ₂ O fixing capacity due to organic matter ..	-0.82	-0.58	-0.39	-0.59	-0.66	-0.42	-0.23	-0.44
Sand fraction ..	0.26	0.22	0.30	0.26	0.37	0.31	0.31	0.33
Silt fraction ..	8.77	4.73	7.17	6.89	10.70	3.96	5.04	6.53
Clay fraction ..	4.63	7.56	8.79	6.99	5.29	7.29	8.92	7.16

proving Joffe² and Martin's³ observation that organic matter reduces the potash fixed by the soil. The potash fixed increased with depth; the reason is not clear and is being investigated.

Potash-fixing capacity of sand was found to be very small in both manured and unmanured soils; the sand fraction in the unmanured soil had greater potash-fixing capacity than the corresponding fraction in the manured one. This contrast is greatest in the first six inches.

The silt fraction of the soil has a large potash-fixing capacity and is on the average 6.89 mgm. percent for the manured and 6.56 mgm. percent for the unmanured. It is highest on the top and decreases in the middle layer, potash-fixing capacity being greater in the top layer of the unmanured soil than in the manured.

Clay on an average has potash-fixing capacity of 6.99 mgm. per cent. for manured and 7.16 mgm. percent for unmanured soils. The potash-fixing capacity increased with depth. Clay in both manured and unmanured has the same potash-fixing capacity.

The surface six inches of unmanured soil thus appears to have developed a considerable amount of potash-fixing capacity due to continuous cropping of wheat which probably may be one of the reasons for obtaining a low but steady wheat yield year after year.

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S. K. MUKERJI.

February 3, 1950.

A NEW RECORD OF PUCCINIA ON SUGARCANE IN BOMBAY

A SERIOUS outbreak of rust on sugarcane (*Saccharum officinarum*), causing extensive damage was reported from the Deccan Canal tract during September-October, 1949. A survey undertaken in the area showed that the rust is prevalent at Belapur, Kopergaon, Belwandi, Ahmednagar, Baramati, Akluj and other canal tracts and was causing serious damage to Co. 475 cane alone, while the other varieties were free from infection. The rust which is caused by a sp. of *Puccinia*, is confined to the leaves and is now being studied in detail. Fig. 1 shows the typical symptoms of



the disease. Casual survey of the affected area showed that infection was heavy, amounting to 50% and over. The crop was three to five months old. The rust has not so far been reported from the other tracts of the Bombay State.

The uredial stage of *Puccinia kuehnii* Butler appears to be quite common on a number of wild *Saccharums* such as *S. arundinaceum*, *S. narenga*, *S. spontaneum*, *Sclerostachya fuscum* in India, Hawaii, Cuba, Java, Australia, West Indies, U.S.A., Philippines, Japan, etc. Butler,

1. Thesis by Wageningen, 1941, 171. 2. *Soil. Sci.*, 1947, 63, 241-247. 3. *Proc. Soil. Sci. Soc. Amer.*, 1945, 10, 1946, 94-101. 4. *Curr. Sci.*, 1949, 18, 375. 5. *Proc. Soil. Sci. Soc. Amer.*, 1943, 8, 1944, 150-53.

however, discovered the telial stage of this rust on *S. spontaneum* from Burma. This, therefore, is the first record of telial stage on cultivated sugarcane (*S. officinarum*). Inoculation experiments carried out in this laboratory have shown that while it can readily infect Co. 475 of *S. officinarum*, it does not infect *Sorghum vulgare*.

The measurements of uredio and teliospores show the following range:—

Spores	Range	Mean
Urediospores	32.2–62.6 × 21.7–41.7	43.3 × 30.8 μ
Teliospores	32.0–85.5 × 16.2–37.1	51.0 × 26.4 μ

While the general characters and description of the spore-forms are similar to those reported by Butler¹ for *P. kuehni*, the size of teliospores obtained from *S. officinarum* (Co. 475) is much larger than that reported by Butler on *S. spontaneum*. The rust is probably a new species and it is proposed to name it *Puccinia sacchari*. Whereas the telial stage of *Puccinia kuehni* occurs only rarely, it is very common in this species collected by us. Further work is in progress.

It may also be stated that Co. 475, a very promising variety of sugarcane, is also highly susceptible to whip smut caused by *Ustilago scitaminea* Syd., which is generally absent in other varieties of sugarcane grown in Bombay State.

Plant Pathological Lab.
College of Agriculture,
Poona 5,
March 16, 1950.

M. K. PATEL.
M. N. KAMAT.
Y. A. PADHYE.

I. Butler, F. J., Fungi and Diseases in Plants, Thacker Spink & Co., Calcutta, .918.

A CALONYMPHID FLAGELLATE FOUND IN THE INDIAN MILLIPEDE, THYROPYGUS (FAM. HARPAGOPHORIDAE)

This is presumably the first record of a flagellate of this kind to be found in the intestinal contents of a millipede. The junior author prepared the smears, by fixing them with Bouin's fluid and staining them with Heidenhain's iron-hematoxylin. Differentiation of the nuclear material was made easy by using saturated picric acid solution.

Metastephanonympha karnatak n. sp.

The form of the parasite is more or less oval, with the posterior pole somewhat pointed.

The outline of the ectosarc is very faint and the whole endosarc is parasitised by hundreds of rod-like bacteria, about 5 to 7 microns long and disposed in longitudinal rows. Such bacteria are also seen free around the flagellate.

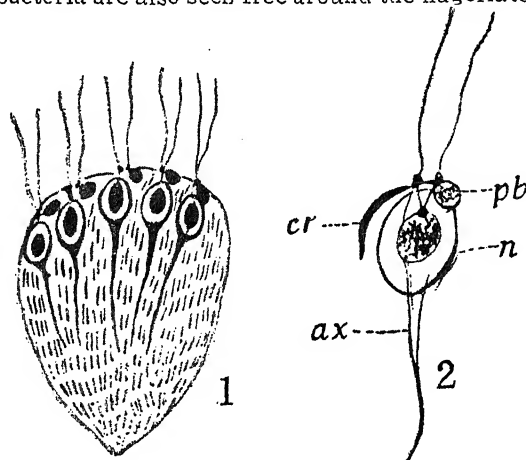


FIG. 1. Calonymphid with 5 mastigonts.

FIG. 2. Structure of a mastigont: *cr* = crest; *pb* = parabasal; *n* = nucleus with its endosome; *ax* = axostyle.

The nuclei of the mastigonts lie in a row close to the outer membrane. The number of the nuclei recorded in 25 individuals is as under:—

No. of Nuclei	..	2	3	4	5	6	7	8	12
Number of parasites	..	2	1	2	6	3	5	5	1

The nuclear endosome is concentrated in a more or less oval mass surrounded by a clear halo bordered by the nuclear membrane. In the anterior pole of the endosome a centriole is connected by two rhyzoplasts to two very distinct basal granules from which emerge two flagella, one from each granule. Beside the flagella, the following organelles are noticed:—

One of the basal granules gives rise to a curved or rod-like *crest* and the *axostyle* which starts as a fine filament crosses the nuclear region and seems to widen a little in the posterior pole of the nuclear membrane, tapering downwards as a filament which stops more or less in the middle region of the body. The axostyles do not collect themselves in a bundle but are nearly lost in the endoplasm as individual units. To the other basal granule is attached a small oval or sacciform *parabasal* similar to that found in the genus *Stephanonympha*.

These two basal granules often very close to each other are in fact interconnected by a

transverse rhyzoplast. The connecting fibrils described as rhyzoplasts are very difficult to detect since they occur in a considerably small area.

Measurements in microns taken in 9 individuals gave:— 34/23; 23/18; 23/20; 23/18; 20/20; 16/16; 13/13; 12/10; (length/breadth), Nucleus $3\frac{1}{2}$ to 4; flagella 5 to 6 microns.

Classification

In the family Calonymphidae Grassi, the genus *Calonympha* possesses only one flagellum in each mastigont. The *Stephanonympha* has four flagella in each mastigont; and the *Diplonympha* has only two nuclei are disposed in two plans, one superficial and the other more deeply imbedded in the endopiasm. The parasite belongs to the genus *Metastephanonympha* DeMello and Brito (1929), which has two flagella. The type species, *M. perronciti* parasite of *Coptotermis heimi*, has more or less a rounded posterior end. Moreover the axostyles anastomose forming a bundle at the posterior pole and the structure of the mastigont especially the cresta is quite different. The flagellate is distinctly a new species which we will name *Metastephanonympha karnataka* n. sp.

We express our thanks to Dr. S. L. Hora, Director, Zoological Survey of India, Calcutta, for getting the millipede identified.

Nova Goa and COL. I. FROILANO DeMELLO.
Dept. of Zoology, J. C. UTTANGI.
Karnatak College,
Dharwar,
January 25, 1950.

1. DeMello, I. F., and Julio Brito, 1929, "Sur un Calonymphide parasite d'un Terme indien," (*Compt. Rend. Soc. Biologie*). 2. "*Metastephanonympha perronciti* n. gen. n. sp., Calonymphide parasite de l'intestin d'un terme de Damão" (*Arg. Esc. Med. Cirurgica de Nova Goa*, Series A, 1929).

SECONDARY INFECTION IN THE BAJRA SMUT DISEASE CAUSED BY *TOLYPOSPORIUM PENICILLARIAE* BREF

FRESH spores of *Tolyposporium penicillariae* collected from a crop sown early at the Institute farm gave very good infection in Bajra ears inoculated while they were very young and still enclosed in the sheath-leaves. Inoculation was made by first removing the sheath leaf in each case and then smearing the spore-balls by means of a brush observing the usual precautions. Ajrekar and Likhite¹ have observed that "no resting period is necessary for the spore-balls to germinate, at least on

artificial media" (italics ours). Our experiments confirm that the spore-balls do not have any dormant period and that they can germinate immediately even on the host and cause infection.

As the fungus can immediately infect its host, and as the incubation period is only about two weeks, secondary infection in a later-sown crop or in ears emerging late may occur. Observations on the frequency of ruptured sori in an infected crop and the gradual increase in number of infected ears in the crop over a period of about two and a half months, from the beginning of September to the middle of November, indicate that such secondary infection does occur in nature.

Div. of Mycology & Plant Pathology,
Ind. Agri. Res. Inst.

R. S. VASUDEVA.

M. R. SESHADRI IYENGAR.

New Delhi,
January 5, 1950.

1. Ajrekar, S. L. and Likhite, V. N., *Curr. Sci*, 1933, 1, 215.

MODE OF TRANSMISSION OF THE LONG SMUT OF JOWAR

THE long smut of Jowar caused by *Tolyposporium Ehrenbergii* (Kuehn) Pat., known both in India and elsewhere, is generally confined to occasional ears, each possessing only a few 'sori', but severe outbreaks, sometimes amounting to about 10% of the total grains in an ear and as much as 44% of the crop have been noted occasionally. In devising control measures against this, as against any other disease, it is essential to know first the mode of transmission of the causal organism. This was unknown till 1945 when Prasad¹ reported the disease to be air-borne. Experiments carried out at this Institute in the same year to determine the mode of transmission were unsuccessful.² Experiments repeated in the two succeeding years also gave negative results.^{3,4} Last season, however, typical infection was successfully produced in more than 50% of the ears of a local variety of Jowar inoculated with spores of the fungus obtained from Punjab (I). The method of inoculation consisted in forcing into the boot enclosing the young inflorescence a suspension of spores in water using a hypodermic needle. The infection appeared 2 to 3 weeks after inoculation and the number of sori produced in individual infected ears varied from 1 to 12.

The failure of the earlier experiments can be ascribed to the prevalence of unfavourable conditions.

vourable climatic conditions in Delhi, where the disease does not generally appear.

Recently, Ramakrishnan and Reddy⁵ while reporting the success of artificial inoculations, observed that the "mode of infection of this smut is so far unknown," apparently overlooking the earlier record by Prasad (*loc. cit.*) However, their findings, as ours, confirm conclusively that the disease is air-borne and that infection takes place either when the inflorescence is still enclosed in the boot, or about the time it emerges, when the flowers are still very young. The source of infection, however, is still obscure. In this disease, as in many air-borne diseases, it is tacitly assumed that spores lying in the soil germinate just when the ears are in a susceptible stage. It is known from the experiments of Ramakrishnan and Reddy (*loc. cit.*), as well as ours, that the spores of long smut do not have any dormancy period and, from the experiments of Kamat,⁶ that they germinate in the presence of sufficient moisture at a temperature varying from 15° to 36°C., the optimum being 28°C. Such conditions of moisture and temperature are presumably available in the soil during different periods of the year. One may suggest, therefore, with equal plausibility, that the infection may come from weed-grasses serving as alternate hosts, though this can only be proved by survey and cross-inoculation experiments. Such experiments are in progress at this Institute.

Thanks are due to Mr. Chetan Swarup Paracer, Assistant Plant Pathologist, Punjab (I), for supplying the material of long smut.

Div. of Mycology, R. S. VASUDEVA.
& Plant Pathology, M. R. SESHADRI LYENGAR.
Ind. Agri. Res. Institute,
New Delhi,
December 5, 1949.

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ANGIOSPERMIC REMAINS FROM BARMER SANDSTONES

WHILE comparing the figures of fossil pollen grains from "Barmer Sandstones" of Jodhpur, reported by Bose,¹ with those in the catalogue of our own collection of living angiospermous pollen grains, we found that they offer a close approach to the pollen grains of the family Onagraceae in their general shape and form, as

also in the presence of germ spores. Bose's figure 4, is almost identical with our figure of *Fuchsia* (Fig. 1); and his figure 3 to *Epilobium*

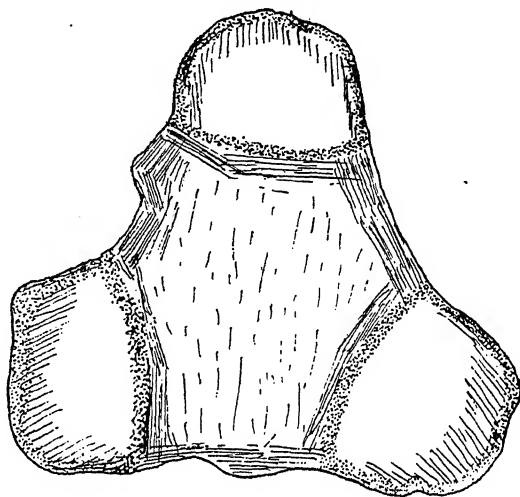


FIG. 1. *Fuchsia*: showing a triangular pollen grain, with three germ pores. 98 μ .

(Fig. 2) and figure 2 to *Chamanerium* (Fig. 3) already described and sketched by Erdtman.²

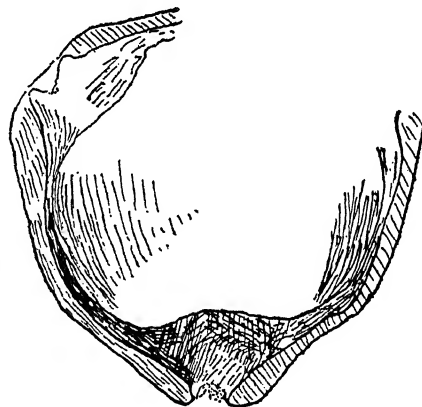


FIG. 2. *Epilobium**: showing the triangular nature of the pollen grains with germ pores. 76 μ .

It is significant that the genera referred to above, all belong to the family Onagraceae. In fact, the pollen grains of this family so far studied in this laboratory³, as well as by Erdtman² and Pope,⁴ all conform to the tricolpate type of Wodehouse,⁵ namely, that they are triangular in outline, provided with one germ pore at each of the angles. Bose's fossil

* Figs. 2 and 3 have been couped out and reproduced from Erdtman (2) for ready reference.

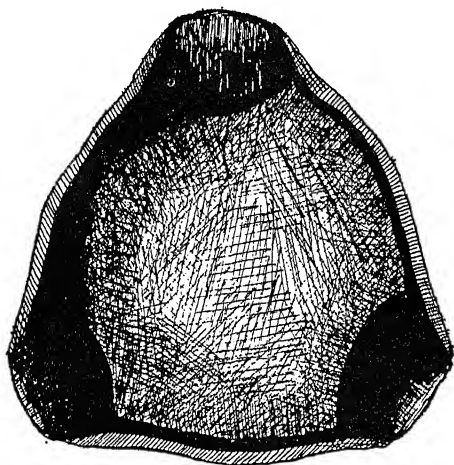


FIG. 3. *Chamanerium**. Ibid. 85 μ .

pollen grains would therefore recall and suggest a comparison with living Onagraceous type of pollen grains.

Dept. of Botany, T. C. N. SINGH.
Annamalai University, A. T. NATARAJAN.
Armamalai nagar,
February 5, 1950.

1. Bose, M. N., "Angiospermic remains from Barmer Sandstones, *Curr. Sci.*, 1949, 18 (7), 246-247. 2. Erdtman, G., "An Introduction to Pollen Analysis," *Chronica Botanica Company of Waltham, Mass., U.S.A.*, 1943, 112-13. 3. Two species of *Fuchsia* and one species of *Jussiaea*. 4. Pope, M. A., "Pollen Morphology as an Index to Plant Relationship," *Botanical Gazette*, 1925, 80, 63-73. 5. Wodehouse, R. P., "Pollen Grains" *McGraw-Hill Book Company Inc., New York and London*, 1935, 152-210.

LEAF BLIGHT OF PANDANUS SPP.

Leaf blight of *Pandanus* plants was observed by the author in the University and National Botanical Gardens, Lucknow, during the rainy season of 1948. A general survey revealed that 2 spp. of *Pandanus*, *P. odoratissimus* (Keora) and *P. fascicularis* were affected by the disease. Microscopic examination revealed that an *Alternaria* which was later determined as *Alternaria tenuis* Auct. (Neergard) was constantly associated with the disease.

The disease is mainly restricted to the leaves. During the rainy season small oval or elliptical etiolated areas arise on the leaf and later on take a darker shade developing into large oval, elliptical or cylindrical areas with their

longitudinal axes parallel to the midrib (Fig. 1). Under high humidity and temperature the spots enlarge, turn black due to preponderance of conidia, coalesce, often covering the entire leaf. In several cases, perforations also appear in the spots, leading to premature defoliation, and consequently to scanty flowering on some male plants of *P. odoratissimus*.

The fungus was cultured on standard synthetic agar medium. Two days after inoculation cottony mycelium appeared and gradually formed a colony having alternate zonations of white and grey colour. When the colony had grown to its full size it became deep black due to preponderance of conidia and was velvety in appearance. The fungus is culturable at various temperatures ranging from 4° C - 32° C. but the optimum temperature is 25° C. It can be cultured on several media, fairly good growth occurring in synthetic, potato dextrose and oat-meal agar medium. In old cultures, crystals like those described by Neergard also appeared.

Conidial observations and measurements were made from 10-12-day old cultures on synthetic medium. The vegetative hyphae are hyaline, septate, and filamentous. Conidiophores in natural conditions emerge through stomata or ruptured portions in cuticle but in cultures arise as side branches on hyphae and are olive brown in colour. Conidia occur in chains of 7-9. They are olive brown in colour, beaked and are obclavate and long oval in shape when mature. Both transverse and longitudinal septa are present and they are generally 5-7 celled (Fig. 2). Beaks are short

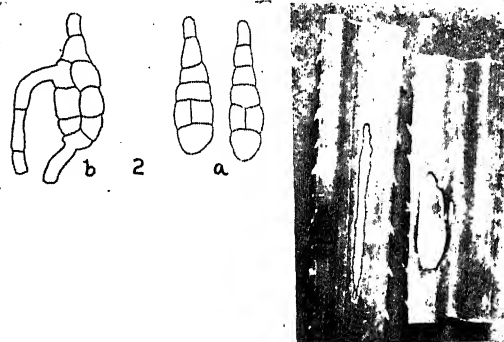


FIG. 1. Photograph showing leaf spots, $\times \frac{1}{2}$. 2a. Camera lucida drawing of conidia, $\times 400$. 2b. Camera lucida drawing of germinating conidium, $\times 400$.

and false having the same colour as that of the spore body. Conidia measure $8-78 \mu \times 6-22 \mu$.

Great confusion prevails with regard to the identification of species of the genus *Alternaria*, first described by Nees in 1817. Elliott's paper gave the first scheme of classification. Later on Nærgard's elaborate description of specific characters made it possible to determine the species without much difficulty.

Pathogenicity of the fungus has been repeatedly tested under uniform conditions partly on seedlings in the garden and mainly on the typical spiral of 3 leaves under aseptic conditions in the laboratory. The leaves were treated with 10% $HgCl_2$ washed well with sterilised water, and spores were introduced on the surface by needle pricks. After about 2-3 days spots appeared which gradually increased and became dark brown. These on being cultured under sterile conditions gave typical *Alternaria tenuis*. This proved the fungus to be a pathogen although a weak one, for the disease could be produced artificially only on wounded leaves. This accounts for the lower leaves being more diseased as they are comparatively less resistant.

Grateful acknowledgments are due to Prof. H. P. Chowdhury for guidance and to Dr. B. B. Mundkur for valuable information. Department of Botany,
University of Lucknow,
Lucknow,
January 16, 1950.

M. KAMAL.

1. Elliot, J. A., *Am. Jr. of Bot.*, 1917, 4, 139. 2. Neergard, P., *Danish spp. of Alternaria and Stemphylium*.

MEGASPORES FROM LOWER GONDWANA OF SINGRAULI COALFIELD, DISTRICT MIRZAPUR

A SAMPLE of coal (Lower Gondwana) collected from a thin seam exposed in a small rivulet north of Kotah ($24^{\circ} 6' - 82^{\circ} 45'$); district Mirzapur (U.P.) (kindly given me by Dr. R. C. Misra) yielded numerous megaspores besides a great number of microspores, woods and cuticles. A good number of megaspores cut in various planes can be seen in thin sections of coal (Fig. 2).

The megaspores vary greatly in size, from about 303μ to about 3 mm. (Fig. 1) in diameter (Some increase in size is no doubt due to their flattening). Most of them are very well preserved and exhibit their tri-radiate mark as well as sculpturing.

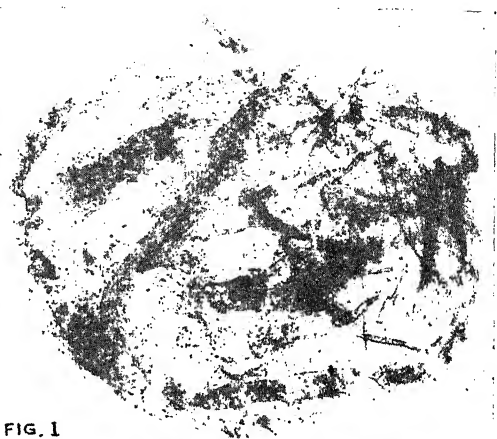


FIG. 1

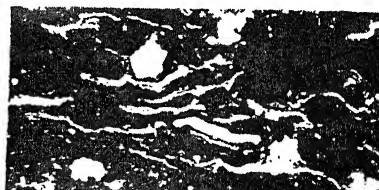


FIG. 2

FIG. 1. Megaspore, $\times 25.6$.

FIG. 2. Thin section of coal showing four megaspores in section, $\times 31$.

Sitholey¹ described only megaspore casts from the Triassic of the Salt Range and only one megaspore is recorded from the upper Tertiary rocks of Assam.² Besides these, the author has not come across any other published record of megaspores, from India. The present discovery of megaspores in great profusion is, therefore, very interesting. It affords evidence of the existence of lycopods in the Palæozoic of India, whose presence is otherwise unknown. A full account of the findings will be published elsewhere.

I wish to thank Dr. R. C. Misra for the loan of the coal sample.

Botany Department,
Lucknow University,
February 25, 1950.

B. S. TRIVEDI.

1. Sitholey, R. V., *Proc. Nat. Acad. Sci. India*, 1943, 13 (5), 300-27. 2. Sahni, B., et al. *Jour. Ind. Bot. Soc.*, 1947, 26, (4), Plate 17, fig. 47.

EFFECT OF PHOTOPERIOD ON THE FLOWERING TIME OF TWO LATE VARIETIES OF PADDY

THE influence of different day length on the flowering time of varieties of paddy from Bengal and Bihar has been studied by Sircar and others.¹⁻¹⁰ Here, the photoperiodic response of

two late varieties of paddy from U.P. (*agahani* or *Jarahan*) when the treatment is given at different stages of growth of the seedlings is reported.

Pure seeds of T. 23 (a selection from *Kala Sukhadas* of Banda District) and T. 36 (a selection from a winter variety of Cuttack), after sterilisation, were sown in flat earthenware pots and transplanted after twenty days to bigger pots containing well mixed soil-manure mixture. New leaves appeared in ten days. The controls were subjected to the full daily period of natural illumination. Of the test the first set was subjected to daylight for 10 hours a day only (8 a.m. to 6 p.m.) when the seedlings were 30 days old; the 2nd, 3rd, 4th, 5th and 6th sets being subjected to this short-day photoperiod when the seedlings were respectively 40, 50, 60, 70 and 80 days old. In each case the short-day treatment was continued till ear emergence was noticed in the individual plants. The method of obtaining the short-day light period is the same as in previous work.⁴ The age of the seedlings was counted from the sowing date. The results are presented in Table I.

day treatment is delayed by a period of 10 days for the successively later sets of 40, 50, 60 and 70 days old seedlings there was a progressive delay in the onset of the flowering time in variety T. 36 and the various sets flowered at about ten days intervals throughout their growth period in contrast to the behaviour in variety T. 23 where the 30 days and the 40 days sets came to flower together. Further, in the variety T. 36, an earliness of 4.3 days was observed even when the short-day treatment was commenced at an advanced age of 80 days but in the variety T. 23 there was no marked earliness when the treatment was started with 70 and 80 days old seedlings. In view of these differences in their responses towards the short-day photoperiod variety T. 36 may be considered a "sensitive" one and variety T. 23 a "less sensitive" one.

Grateful thanks are due to Prof. Shri Ranjan for his helpful criticism and guidance during the course of this investigation.

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University of Allahabad,
February 22, 1950.

TABLE I

Sowing date, June 26, 1949. Transplanting date, July 16, 1949. + indicates induced earliness; — indicates induced delaying effect.

Serial No. of the sets	Date on which the treatment was commenced	Age of the seedlings in days at the time of the commencement of the treatment	Period from sowing to first panicle emergence in days (average of 24 plants)		Difference from control in days	
			Var. T. 36	Var. T. 23	Var. T. 36	Var. T. 23
1	July 26	30	67.6	82.8	+46.1	+29.9
2	Aug. 5	40	77.0	83.2	+36.7	+29.5
3	Aug. 15	50	86.9	92.7	+26.8	+20.0
4	Aug. 25	60	95.9	102.3	+17.8	+12.4
5	Sept. 4	70	107.0	112.2	+ 6.7	+ 0.5
6	Sept. 14	80	109.4	113.4	+ 4.3	- 0.7
7	Control		113.7	112.7		

A study of the results in Table I shows that short-day treatment from early stages of growth of the plants greatly hastens the date of the first panicle emergence in the two varieties of rice under observation. But there is a good deal of varietal difference between the two. In case of variety T. 36 the maximum earliness observed is 46.1 days when the treatment is started with 30 days old seedlings whereas the corresponding figure for the variety T. 23 is only 29.9 days, although the normal flowering period in both the varieties is almost the same. As the date of the commencement of the short-

1. Alam, M., *Det. Sci. Rep. Rice, Res. Stat. Sabour, Bihar (India)*, 1940-41.
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10. —, and Parija, B., *Proc. Nat. Inst. Sci. India*, 1949, **15**, 93-107.

INDIAN ROSIN OIL FROM *PINUS EXCELSA*

THE problem of the effective commercial utilisation of various types of indigenous resins, and in particular the disposal of inferior grades of Indian rosin, considerable quantities of which are available, has as yet found no satisfactory solution. In western countries, rosin oils are used in the preparation of lubricants, varnishes, inks, antiseptics, etc. In order to study the chemical nature and to isolate the chemical ingredients as far as possible of a similar product from indigenous rosins, a rosin oil has been prepared from the rosin (12.5 kg.) from *Pinus*

excelsa by the method of destructive distillation in iron retorts in an yield of 75%.

Besides the oil, considerable amount of gas and a very porous residue consisting mainly of carbon are also obtained. The oil was separated from aqueous distillate and after removal of acidic constituents by shaking with 5 per cent. sodium carbonate solution, was fractionated repeatedly. The sodium carbonate extracts from every fraction were evaporated to dryness and the acids were isolated by treating the residue with concentrated sulphuric acid. Individual acids were separated by repeated fractionation and identified as their anilides and *p*-toluidides. The solid acids which consists mostly of abietic acid was isolated from fractions E, F and G, crystallised from glacial acetic acid and identified.

The individual fractions of the neutral oil were examined separately by repeated fractionation using an efficient Vigreux partial condensation take-off type column, and the individual fractions analysed. Fractions boiling above 250° gave uniformly high yields (40-50%) of retene on dehydrogenation with selenium.

The results are summarised in Tables I and II.

A proximate composition of the distillate is given below. (Figures within the brackets indicate the percentage on the weight of the distillate.)

Total volatile acids expressed as acetic acid	..	..	(1.5)
Total non-volatile acids expressed as abietic acid	..	..	(3.5)

TABLE I

	Weight in gram.	Percentage yield on the weight of the rosin	Products isolated
Gases	.. ..	16.26	CO ₂ , 64.1%; CO, 9.3%; O ₂ , 3.7%; H ₂ , 8.9%; C ₂ H ₄ , 2.9%; C ₂ H ₂ , 13.0%
Aqueous Distillate	710.5	5.9	Acetic acid, Propionic acid.
Acidic Constituents	292.8	2.39	Isobutyric acid, isovaleric acid, and abietic acid
Oily Distillate	.. 7913	64.6	See Table II
Residue	.. 1050	8.57	Mainly carbon with traces of iron oxide and silica

TABLE II

No.	B.P. Range	% on the wt. of the Rosin	Sp. Gr. D ₄ ^{15.5}	Refractive index n _D ²⁵	Specific Rotation [α] _D ²⁴	Absolute Viscosity	Acid Number	Saponification Value	Iodine Value	Individual Compounds Characterised
A	Up to 150° C.	1.23	0.8344	1.4653	3.521	0.9235	30.63	30.21	87	Isobutyric aldehyde, methyl alcohol, 2-hexene, methyl cyclohexane, Toluene, <i>p</i> -xylene, acetic acid & propionic acid
B	150°-250° C.	2.16	0.9053	1.4929	19.618	2.586	14.34	14.8	73	<i>p</i> -Xylene, isobutyric acid, isovaleric acid, cumene, <i>α</i> & <i>β</i> pinenes, & <i>p</i> -cymene
C	250°-290° C.	2.5	0.9670	1.5262	47.364	25.13	7.77	7.69	71	Abietic acid, various hydrogenated derivatives of retene.
D	290°-330° C.	31.84	0.9774	1.5373	49.092	83.12	6.62	6.6	69	e.g., dihydro retene tetrahydro retene, octahydro retene, perhydro retene, abietene and retene
E	180°-210° C./10 mm.	17.96	0.9393	1.5554	36.71	123.6	3.098	5.23	69	
F	210°-235° C./10 mm.	7.44	1.011	1.5750	30.8	459.8	25.82	28.6	58.5	
G	Above 235° C./10 mm	1.44	..	..	15.728	..	36.17	36.53	..	Mainly retene and abietic acid

Aliphatic unsaturated hydrocarbones	(0.4)
Isobutyric aldehyde	(0.2)
Methyl alcohol	(0.15)
Methyl-cyclohexane	(0.4)
Total aromatic hydrocarbons ..	(1.5)
Total pinenes	(0.4)
Abietene and Hydro derivatives of retene	(70-80)
Retene	(1.4)

Isovaleric acid, 2-hexene and *p*-xylene are present in the rosin oil from *Pinus excelsa* and these compounds have not been reported in any of the rosin oils from the pine^{1, 2, 3}.

Organic Chemistry Laboratories,
Indian Institute of Science. I. S. PATEL.
Bangalore 3, P. C. GUHA.
April 3, 1950.

1. Renard, *Ann. de Chimie et Physique*, 6^e serie, 1884, p. 223. 2. Kelbe, *Berichte*, 1880, 13, pp. 1157 and 1827; 1881, 14, p. 1240. 3. Kelbe, *Ann. de Liebig*, 1881, 210, p. 1.

THE EFFECT OF INTAKE OF ZINC ON METABOLISM PART A

It was pointed out earlier¹ that the intake of zinc exerted an influence on the fat content of liver in the rat when it was supplemented to a high fat, low protein diet and that irrespective of the nature of the diet, zinc supplements adversely affected the development of the bones. Prabhu² records that zinc is used to cure infantile cirrhosis of liver in the indigenous systems of medicine. It was therefore of interest to find out if zinc influenced the metabolism of nitrogen, phosphorus and sulphur in rats fed on a stock diet and high fat, low protein diet.

Table I presents the results of experiments conducted on three groups of four rats each with a view to studying the effect of zinc (supplied as zinc oxide at 0.5 and 1.0 per cent. levels) on the metabolism of N, P and S in rats on a stock diet.

The results show that supplements of zinc affect metabolism of all the constituents studied. While urinary excretion of nitrogen is affected only at the higher level of zinc, faecal excretion and retention are altered to a very appreciable extent at all the levels of zinc tried. Its influence on the metabolism of phosphorus and sulphur appears to be more marked. Thus there is a considerable decrease in urinary excretion and retention and a corresponding increase in faecal excretion of these

TABLE I
Metabolism of nitrogen, phosphorus and sulphur in rats fed on a stock diet supplemented with zinc

Diet	Urinary* mg.	Faecal* mg.	Retention* mg.
<i>Nitrogen :</i>			
Stock diet alone	338.71	892.76	2646.63
Do. plus 0.5% ZnO	355.08	1091.17	2186.35
Do. plus 1.0% ZnO	536.20	1121.65	1790.75
<i>Phosphorus :</i>			
Stock diet alone	41.37	143.79	526.44
Do. plus 0.5% ZnO	4.29	477.79	239.52
Do. plus 1.0% ZnO	4.59	573.23	54.78
<i>Sulphur :</i>			
Stock diet alone	23.94	86.90	-53.15
Do. plus 0.5% ZnO	15.76	129.25	-86.51
Do. plus 1.0% ZnO	16.84	155.50	-121.04

* Total for a period of fifteen days and average for the group consisting of four rats.

constituents as a result of the supplements of zinc. These observations lead to the conclusion that zinc in some manner affects the assimilation of these constituents in the intestines, so that the reserves of the body are mobilized in order to maintain their concentration in the body fluids. This appears to be the reason for the retarded growth rate and poor development of the bones of rats fed on a diet supplemented with zinc and possibly also for other toxic symptoms reported by Sutton and Nelson³ and Smith and Larson.⁴

In experiments conducted with high fat, low protein diets also, observations substantially similar to the above were made.

Table II shows that zinc causes an increase in the urinary excretion of both uric acid and total creatinine when the basal diet consists of the stock ration. This may be because of the general wastage especially of the muscle tissues. On a high fat, low protein diet, uric acid excretion shows a slight tendency to decrease. As far as the excretion of creatinine is concerned, the composition of the diet appears to make some difference in that while zinc tended to increase the urinary excretion of creatinine in rats on a stock diet, it lowered its excretion in those fed a high fat, low protein diet. The reason for this difference is not clear.

The manner in which zinc lowers the fat content in the liver of rats fed on a high fat, low protein diet is also not quite clear, but it

TABLE II

Excretion of uric acid and total creatinine in the urine of rats fed on a stock diet and a high fat, low protein diet supplemented with zinc

Diet	Three-day periods					Total
	1	2	3	4	5	
Milligrams						
<i>Uric Acid:</i>						
Stock diet alone	0.242	0.762	0.778	0.929	1.182	3.893
Do. <i>plus</i> 0.5%						
ZnO	0.378	0.843	0.971	1.036	1.056	4.284
Do. <i>plus</i> 1.0%						
ZnO	0.504	1.033	1.139	1.381	1.390	5.447
High fat, low protein diet	0.202	0.170	0.532	0.278	0.429	1.611
Do. <i>plus</i> 0.5%						
ZnO	0.311	0.418	0.446	0.141	0.259	1.575
Do. <i>plus</i> 1.0%						
ZnO	0.227	0.211	0.238	0.139	0.191	1.006
<i>Total Creatinine:</i>						
Stock diet alone	1.700	1.373	2.064	2.173	5.303	12.613
Do. <i>plus</i> 0.5%						
ZnO	2.178	2.218	3.041	2.984	3.976	14.397
Do. <i>plus</i> 1.0%						
ZnO	2.116	2.909	4.291	4.822	6.473	20.611
High fat, low protein diet	0.958	1.078	1.075	2.773	5.964	11.848
Do. <i>plus</i> 0.5%						
ZnO	0.958	1.312	2.382	1.822	2.259	8.733
Do. <i>plus</i> 1.0%						
ZnO	1.208	1.466	1.594	1.227	1.373	6.868

that in rats fed a diet supplemented with zinc, there should be an appreciably greater excretion of fat in the faeces than in the control. But this appears not to be the case. Further investigation is in progress.

PART B

In an experiment designed to find out the metabolism of fat in rats fed on a high fat, low protein diet with and without the supplement of zinc, it was observed that faecal fat did not show any appreciable increase in the zinc-fed group during the period of fifteen days (Table III).

These results show that fat is assimilated without impairment even when the assimilation of phosphorus from the intestines is poor and thus support the contention of Frazer⁵ who has adduced some evidence to show that phosphorylation of fat is not a necessary intermediate step in its assimilation from the intestines. The explanation for the lipotropic action of zinc has, therefore, to be sought for elsewhere.

It is a pleasure to thank Major-General Sir S. S. Eckhey and Dr. K. Ganapathi for their interest in this work.

Haffkine Institute,
Bombay,
January 18, 1950.

V. SADASIVAN.

1. Sadasivan, V., *Curr. Sci.*, 1950, **19**, 10. 2. Prabhu, M. B., *Indian J. Pediatrics*, 1940, **7**, 121. 3. Sutton,

TABLE III

Metabolism of fat in rats fed on a high fat, low protein diet supplemented with zinc

Diet	Three-day periods					Total
	1	2	3	4	5	
Grams						
<i>Fat in Diet :</i>						
High fat, low protein diet	6.248	6.075	5.880	5.745	5.380	29.328
Do. plus 0.5% ZnO	4.820	3.940	4.205	4.235	4.145	21.315
<i>Faecal Fat :*</i>						
High fat, low protein diet	0.1483 (2.375)	0.1982 (3.263)	0.1197 (2.036)	0.1125 (2.010)	0.2656 (4.937)	0.8443 (2.879)
Do. plus 0.5% ZnO	0.1523 (3.159)	0.1207 (3.063)	0.0775 (1.367)	0.2201 (5.234)	0.1376 (3.319)	0.7082 (3.323)
<i>Fat Assimilated :</i>						
High fat, low protein diet	6.0997	5.8768	5.7603	5.6295	5.1144	28.4807
Do. plus 0.5% ZnO	4.6677	3.8193	4.1275	3.9849	4.0074	20.6088

* Figures in brackets indicate faecal fat as percentage of dietary fat.

is likely that zinc, by inhibiting the phosphorylation of fat to form phospholipids, prevents its migration from the intestines to the liver. In this event, it is to be expected

W. R., and Nelson, V. E., *Proc. Soc. Exp. Biol. and Med.*, 1937, **36**, 211. 4. Smith, S. E., and Larson, E. J., *J. Biol. Chem.*, 1946, **163**, 23. 5. Frazer, A. C., *Physiol. Revs.*, 1946, **26**, 310.

ANTIBIOTIC PROPERTIES OF LIVER-
PROTEIN HYDROLYSATE

GOAT being the more common animal used for meat in India, most liver extracts in this country are naturally made from this biological source.

The usual method of making liver extracts is by digesting the liver with papain. The concentrated aqueous filtrate is treated with strong alcohol upto 70% to give precipitate (No. I). The alcoholic solution is again concentrated in vacuum and further treated with strong alcohol bringing the mixture as before to 70% to obtain precipitate (II). Dried at 70° C. under vacuum, the peptone, originally white, oxidises to a brown mass, due probably to tyrosine. Precipitate (II), on drying to a constant weight, gave 14% nitrogen; solubility in water about 10%; pH of saturated solution was 4.5; nitrogen content 1.4%, representing 8.75% protein; amino-nitrogen, by formal titration. 0.6%. Qualitative tests for tyrosine, tryptophane, methionine and cystine were all positive. Active charcoal, "Norit K" adsorbed the dark colour, but the pale straw-coloured filtrate still indicated the presence of all the four amino acids mentioned above.

Precipitate (II) does not function as peptone for bacteriological purposes. A 3.6% solution of this liver-peptone, indicated anti-biotic properties. The 10% solution of liver-peptone of pH 4.5 was diluted and ammonia was added to give the concentrated solution a pH of 7.0, which was further diluted as indicated in Table I.

The solution, which had about 4% liver peptone after adsorption, was just resistant to natural infection by putrefying bacteria, whereas solutions containing 3% and less were not.

The colour adsorbed by charcoal, as measured with Lumetron, indicated 64% adsorption leaving 36% behind comparable with a solution containing 3.6% liver-peptone of Table I. The

TABLE I
Effect of diluting liver peptone solution on
bacterial growth

Concentration of dry liver peptone	Visual turbidity	Smell after 4 days
10%	Nil	Normal
5%	"	"
4%	"	"
3%	Turbidity, bacteria present	Putrefaction after 24 hrs.
2%	"	Worse
1%	"	Worst

findings with colour adsorption, given in Table II, thus confirm the data presented as different strengths of peptone solution given in Table I.

TABLE II
Effect of adsorbing the antibiotic factor of
"Norit K"

"Norit K" added	Colour adsorbed in percentage	Putrifaction after 4 days
100 mg.	..	10 Nil
200 mg.	..	32 Nil
500 mg.	..	64 Nil
1 G.	..	83 Putrefaction after 24 hrs.
2 G.	..	97.6 "
3 G.	..	98.5 "
4 G.	..	99.8 "
5 G.	..	100 "

The antibiotic properties of protein hydrolysate appears to have been rarely recorded.¹ Tables I and II offer *in vitro* experiments explaining in part the mechanism of natural immunity.

Cipla Laboratories,
Bombay 8,
December 12, 1949.

S. MAHDIHASSAN.
V. M. BAKSHI.

1. Natini and Lynch, *J. Pharm. Exp. Ther.*, 1947, 90, 313—through *Manuf. Chemist*, 18, 565.

ERRATA

The following paragraph must be included on page 84, March 1950 issue of *Current Science*, at the end of the paper entitled "Palana, Lignite (? eocene), Bikaner," by A. R. Rao and K. P. Vimal, just before the last paragraph:—

"S. R. N. Rao and Misra (*Current Science*, Oct. 1949, p. 380) have already reported

the occurrence of a *Botryococcus Brawni* (-like alga) in these lignites. The present note records for the first time the occurrence of various kinds of fossil pollen in the same material. A fuller account of the microfossils in these lignites, which are being studied further, will be published elsewhere."

REVIEWS

Chemical Engineering Plant Design. By F. C. Vilbrandt. (McGraw Hill), 1949. Pp. vii + 603. Price \$ 6.00.

Most of the successful laboratory processes for chemical production cannot be majored into commercially feasible propositions unless they are piloted carefully through medium scale engineering stages. The chemical and engineering informations obtained thereby, are then to be co-ordinated into a design for an assembled full-scale chemical manufacturing plant. The design of a preliminary pilot plant from the available laboratory experimentation data, as also that of a full-scale production plant involve a careful consideration of quantitative flows of materials in process, specification and organisation of the major and the auxiliary equipment, and a study of storage and expansion. Such a design has finally to be analysed by a preconstruction cost accounting for an appraisal of its success as a commercial venture.

An outstanding text and reference book dealing precisely with this aspect of design of assembled plant was first published by F. C. Vilbrandt in 1934 and has remained as a *vade mecum* particularly for all the initiates into the Practice of Chemical Engineering. Since the first publication of the book, no revolutionary changes have been introduced into the principles of plant design, but a considerable amount of very useful data on equipment and materials have accumulated in published literature. Prof. Vilbrandt has therefore taken a timely and much welcome step in bringing out a thoroughly revised third edition of his book. How thorough the revision has been, can be immediately gauged from the fact that the bulk of the book has increased from 341 pages in 1934 to 587 pages in the present edition.

This opportunity has been taken also to rearrange the thirteen chapters of subject-matter into better logical sequence. The chapter that has received the greatest attention by way of a very material revision and expansion, is the one dealing with "Preconstruction cost accounting" which now includes cost indexes and all of the most recent cost data. Such a considerable expansion of this chapter from 41 pages to 135 pages, has created markedly the need—which it is hoped will be fulfilled in the next edition—for a page schedule of the

chapter subdivisions, particularly as this will be a much used reference chapter. A corresponding schedule for the other chapters as well, would also be welcome, although this has been indicated but not exactly, on page 3, in the body of the book.

Attention must also be drawn to another material change in the book due to the substitution of the illustrative design problem on ferrous sulphate recovery by a new complete project on a "gamma-benzene hexachloride production unit" which has been worked out in good detail.

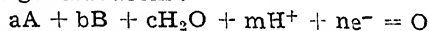
The get-up of the book is up to the usual excellent standards of the publishers. A few misprints have been noticed such as 14519 for 14319 under "B-1, chlorinator" on page 259, and the rather obvious errors in the first six lines on page 269.

Vilbrandt's book takes a high rank among chemical engineering texts, and will continue to be popular and highly useful.

M. A. G. RAU.

Thermodynamics of Dilute Aqueous Solutions. By M. J. N. Pourbaix.* Translated by J. N. Agar, with a Foreword by U. R. Evans, with numerous diagrams. (Edward Arnold & Co., London), 1949. Pp. xv + 136. Price 30sh. net.

The book under review gives a generalised thermodynamic treatment of chemical and electrochemical changes in aqueous solutions. For this purpose the author writes all reactions in the general form :



in which the substance (or group of substances) A, changes into the substance (or group of substances) B, the only other species involved being H_2O , H^+ and electrons e^- . The method of treatment may be novel to many, but leads to the interesting result that equilibrium can be generally expressed as a function of the same two independent variables, viz., pH which determines the influence of H^+ ions and the potential E which determines the influence of electrons. The reactions are then divided into two main classes : (i) those without oxidation, and (ii) those with oxidation. Reactions of class (i) are subdivided into : (A) those in which neither H^+ ions nor electrons are involved, and (B) those in which H^+ ions play a part. Similarly reactions of class (ii)

are subdivided into: (C) those involving electrons, and (D) those involving electrons and H^+ ions. Such a classification at once leads to the following results:—

Reactions of class (i) A will be independent of pH and potential;

Reactions of class (i) B will depend on pH but not on potential;

Reactions of class (ii) C will depend on potential but not on pH; while

Reactions of class (ii) D will depend on both pH and potential.

The author then derives general equations representing equilibria in which the equilibrium constant and potential are obtained in terms of standard chemical potentials of the various species involved:—

$$\log K = \frac{\sum \nu_i \mu_i^0}{1363}$$

$$E_0 = \frac{\sum \nu_i \mu_i^0}{23,060 n}$$

He has thus been able to treat a variety of reactions in the same general manner. He has also devised a graphical method of representing the influence of these factors on equilibria, homogeneous and heterogeneous.

In the words of Dr. Evans, the method of treatment "offers a common elucidation of numerous problems which are today regarded as quite distinct, and concentrates a vast mass of pertinent data in diagrams which, to those who have gained familiarity with his system, are remarkably simple". (Italics the reviewer's.) To gain familiarity with his system is not so simple. The monograph is by no means easy reading.

More explanations are needed in the construction of the graphs and their interpretation. The calculations require a knowledge of standard chemical potentials of the various species concerned, the values of which for all substances are not yet available, a fact recognised by the author also. This limits the usefulness of the book, but provokes future research.

The monograph cannot be used with advantage by a beginner, but the advanced student will find it a thought-provoking and stimulating contribution to thermodynamics.

S. N. SHUKLA.

Co-operative Rural Development in India: a Plan. By G. P. Shukla (Published by The Universal Publishers Ltd., Lucknow), 1949. Pp. 152. Price Rs. 3/12.

The Royal Commission on Agriculture in India observed as early as in 1927 that if co-operation failed, there would fail "the best hope of rural India" and nearly 20 years later the Co-operative Planning Committee (one of the many that the Government of India appointed in those delirious days of Planning, 1943-45) said, "The Co-operative Society is the most suitable medium for the democratisation of economic planning, as it provides the local unit which can fulfil the dual function of educating public opinion in favour of a plan and of executing it." On the basis of these principles, the author has analysed the problems of rural reconstruction through the establishment and proper working of the Panchayats. He proposes a Panchayat which he would term the Gaon Sabha in every village as a multipurpose co-operative society—with an elected Committee of Management to be called the Gaon Panchayat. He critically surveys the United Provinces Panchayat Raj Act of 1947, and suggests that in every village this panchayat and the co-operative society must be combined into a single organization—not only for assisting the development of agriculture, commerce and industry as contemplated in the aforesaid Panchayat Raj Act, but also for providing for medical aid, cattle farming, education, sanitation, roads, marketing, liquidation of indebtedness and development of co-operation and establishment of improved seed and implement stores, and the welfare of the village 'abadi' and its residents in every aspect of life. It must be noted that the author is aware that "the Co-operative movement has not been a success in India", during these last 46 years, in fact he discusses briefly the causes of its failure. It will, therefore, require all the faith of a Co-operator in the reader when he has to pursue the details of the organization, functions, powers of the Panchayats and their application not only to Agriculture and Allied Industries, but to educational reconstruction, administration and finance with plans ranging from the building of the Panchayat to the consolidation of families—in order that "Every thing in the village must be made to undergo change for the better, so that the villager may forget his past miserable condition, his dead soul may be revived and new energy and spirit may invigorate him." May this optimism be shared by the reader!

M. C. M.

* The author, Dr. Pourbaix is, of Belgian nationality, has had a distinguished educational career and has collaborated with Professors Dony and Erculisse of Brussels and Scheffer and Burgers of Delft besides others. He is now organizing the Research Group at the Universite Libre de Bruxelles.

Vegetable Gums and Resins. By F. N. Howes, D. Sc. [Published by The Chronica Botanica Company, Waltham, Mass., U.S.A.), 1949. Obtainable from Messrs. Macmillan & Co., Calcutta, Bombay and Madras. Pp. 188 with 39+2 figures, being reproductions of pen and ink drawings. Price \$ 5.

Gums and resins are mainly used in industries as raw material for varnishes, and as such the book would be mostly read by industrial chemists but by the nature of the materials handled only a botanist can write upon them. The author is the Principal Scientific Officer of the Royal Botanic Gardens, Kew, London, and as such most qualified for enlightening the reader upon gums and resins. The printing is excellent and the price very reasonable. We have no doubt that it would prove very useful and that a second edition would soon be called for. The following suggestions are made in the hope that the future edition would prove still more useful than the present one.

What an industrial chemist would like to see is not the plants that produce gums and resins but what the products themselves look like. Of the 39 figures in the text only one, Fig. 6, in part, shows for example gum tragacanth adhering to a piece of a branch; the rest are all pictures of branches, leaves and even flowers such as interest a pure botanist but would appear as mere decorations to the real user of the book, the industrial chemist. On the contrary the two extra pictures entitled "Collecting mastic" and "Collecting Frankincense" go to increase human interest in the subject by their appeal to our historical and artistic sense.

The user of the book would like not only to see "what looks what" but also "what grows where". There are only two maps to satisfy the reader's curiosity in this respect. Both these figures, we fear, are too small to serve their purpose well. Gums and resins differ very greatly from locality to locality and the main regions should have been better indicated. For example, Fig. 1 represents India in such a small size that the space is not sufficient to bear the four figures it is made to carry. No. 2, for example, in this map indicates "Other Acacia Gums" and the region is that of Gujrat, as if no other part of India comes into question. Fig. 20 shows India of the same size bearing two figures where the spot allotted to No. 1 again corresponds with Gujrat but is supposed to show the region where Rosin or Colophony is produced.

Lac is an insect product, but is included in the book and with justification. As a botanist the author is not expected to be in touch with entomological literature and as such one is surprised to find that one and the same insect is supposed to grow from the plains of Kashmir and Tibet down to Travancore and from the province of Sind in the west to Indochina, in the extreme east.

S. MAHDIHASSAN.

Some Vertebrate Animals of Ceylon, Vol. I. By P. E. P. Deraniyagala. (The Director, National Museum, Colombo), 1949. Pp. ii+119. Price Rs. 3.50 or 7s.

To keep the public informed about the faunistic collections made by museums, publications of the type under review are essential and rightly does the Minister of Education, Ceylon, observe in his Foreword, that "It is one of the most important functions of Museum workers to gather new knowledge together in volumes of this type".

'Some Vertebrate Animals of Ceylon' forms the first of the series and coming as it does under the authorship of Mr. Deraniyagala, the æsthetic aspect and as well the scientific accuracy in delineation are perfect.

Ceylon broke off from peninsular India nearly twenty million years ago and though the fauna resembles that of the mainland, the hand of isolation has also played its part on the island. The three peneplains are characterised by their respective fauna with a certain amount of overlapping. Fishes, reptiles, birds and mammals are figured and their scientific names with vernacular equivalents are given.

The figures could have certainly been reproduced better, particularly the photographs. We are asked to note the eggs in the pouch of *Urocampus* (Pl. 20) but it is impossible to make out anything. In some figures an arrow is drawn; what it indicates, it is not described anywhere: presumably the anus. On p. 60, we read that the poison fangs of the cobras, etc., are grooved at their back. This is not so; the groove is always on the anterior face of the tooth. It is also not clear what part of Python the three figures at the bottom of p. 66 are intended to represent.

We presume that this atlas will form a valuable guide to those who visit museums but it is priced high to be within the reach of the common man.

L. S. R.

Scoliodon: Indian Zoological Memoirs, No. II.

By E. M. Thillayampalam. *Third Edition*, pp. x + 125, 87 coloured plates and text figures (Lucknow Publishing House, Lucknow). Price Rs. 3-12-0.

The third revised edition of this Memoir on a shark of the Indian Seas (first published in 1928) just issued is a sufficient indication of its value and usefulness for teachers and students of Indian Zoology. It is one of the excellent series of Memoirs on Indian Animal types, planned and edited by Prof. K. N. Bahl of Lucknow.

In the new edition, the text has been suitably revised by the editor himself so as to provide a more functional tone to the anatomical details. Among other improvements may be noted the sections on the new classification of Elasmobranchs and modern views on the freshwater origin of fishes, on cartilage as an embryonic adaptation rather than as primitive skeletal material, on the urea content of elasmobranch blood and its osmotic function, on the functions of the central and autonomic nervous system and on the thermo-receptive function of Lorenzini's ampullae. Further, every chapter has been critically revised on the lines of most recent work. The Memoir is very well printed and is exceptionally good value for the price.

B. P.

The Measurement of Air Flow. By E. Ower. (Chapman & Hall, Ltd.), 1949, Pp. vi+293. Price 30s.

This is the third edition of a very useful book which first appeared in 1927. Recent advances in fluid dynamics and the techniques developed in experimental aerodynamics naturally call for frequent revisions and the author has attempted in this addition to bring the subject-matter up-to-date.

2. The book is written essentially from the physicist's point of view and all fundamental formulæ and theorems are fully explained; but it would perhaps have enhanced the value of the book if for the benefit of the engineer greater emphasis had been placed on certain practical details and applications, pointing out the experimental difficulties met with, in the measurement of wind speed, turbulence, etc., in wind tunnels.

3. The general presentation of the matter is very satisfactory and the author gives an excellent introduction to the methods and techniques of fluid flow measurement with sufficient theory to make the book self-contained. It may, however, be pointed out that certain parts are not quite up-to-date. For instance, in the section on "Diffusers and Sudden Expansions" the author has confined himself to low speed flow only. In recent years the design of diffusers for high speed wind tunnels has presented many problems. Conventional ideas have not worked successfully and the diffuser types suitable at low speeds are not quite satisfactory at high speeds. Certain unconventional devices have been adopted which have resulted in greater efficiency. Although most of the work done in this field is secret, a reference to recent investigations and a discussion of the problems met with would have been very appropriate.

4. Again Chapter X on the methods of flow measurement based upon the rates of cooling of hot bodies is, it is feared, not sufficiently comprehensive although the fundamentals have been properly stressed. There is no reference to the excellent work of Dr. H. L. Dryden and his associates relating to the application of the hot wire anemometer to the measurement of turbulent and boundary layer flow and the techniques perfected for this purpose.

5. In a general way it is unfortunate that reference to American work should be meagre, since during the last decade the centre of gravity of aeronautical research has to a large extent been shifting towards America.

6. On the whole the author is to be congratulated for his very straight forward and clear presentation of the subject. It should be extremely useful to those engaged in investigations involving accurate measurement of air flow.

7. The general get-up of the book comes up to the usual high standard of Messrs. Chapman & Hall despite economies. The subject index and the author index have, however, been combined together, and might have been given separately with advantage.

P. N.

SCIENCE NOTES AND NEWS

Egyptian Scholarships for Indian Students

In pursuance of their desire to offer reciprocal facilities to Indian students for studies in Egypt and with a view to promoting cultural relations between the two countries, the Government of Egypt have offered three scholarships to Indian students for post-graduate studies in Archæology, Philology and Agriculture with effect from the academic year 1950 at the University of Fouad the 1st. Teaching in Archæology and Philology is done in English while the medium of instruction for Agriculture is Arabic. It is, however, necessary that all intending candidates should possess a fair knowledge of Arabic.

The scholarships will be tenable for the period necessary for the student to acquire a degree in the course for which he is selected, and depending upon the satisfactory progress of the student. The value of the scholarship is fixed at LE 15 p.m. which corresponds to Rs. 205 p.m. apart from the tuition fees which will also be provided by the Egyptian Government. The cost of transportation and other personal expenses will have to be borne by the selected candidates.

Candidates must be *bona fide* residents of India and must possess a Bachelor's degree from a recognised Indian University.

Intending candidates must submit their applications in triplicate in the prescribed forms through the Universities concerned so as to reach the Ministry of Education (Section A-1), Government of India, New Delhi, before April 30, 1950. The prescribed application forms can be had from all Universities in India who have been requested to recommend names.

Industrial X-Ray Plant at Alipore Test House

A 250,000 volt industrial X-ray plant capable of examining steels up to 3" in thickness and lighter metals and alloys up to any thickness normally used in industry has been installed at the Government Test House, Alipore, Calcutta.

The plant at Alipore Test House is available for utilisation by Government departments, public bodies, and manufacturers concerned. Further information about tests, testing fees, etc., may be obtained on application from the Director, Government Test House, Alipore,

Calcutta 27. Applicants should give full details of the materials intended to be tested.

Federation of Chemical Industries of Belgium Directory for 1950

[The 1950 Directory of the Federation of the Belgian Chemical Industries which has just been issued, contains much useful information on the following subjects: organisation of the Federation, complete list of the names of the members and their addresses, detailed list of chemicals manufactured and sold by them, trade marks of the products and an alphabetical list of the same in Dutch, English, Spanish and German. The volume runs to 450 pages and is sold at 150 B. Franks + 20 B. Franks for postage, payable by check through any intermediary of a Brussels banking-house.

The All India Plastics Manufacturers' Association

The Third Conference of the All India Plastics Manufacturers' Association is being inaugurated by His Excellency Dr. Kailash Nath Katju, Governor of West Bengal, on the 14th April 1950, at Calcutta, under the presidency of Sree P. D. Himmatsingka. During the last year the Association have organised numerous committees for the consideration of details concerning important matters such as standardisation of wages, sales organisation, protection for industry, licence supervising, standardisation of the indigenous raw materials and Central powder manufacturing.

As regards the manufacture of raw materials, the scheme of the Association is taking shape, and it is encouraging that the Government of India is also behind this move, and would be glad to see a Central unit for the manufacture of raw materials. At the present Conference, the Association proposes to discuss various important matters relating to the Tariff Board report and planning the industry on a more scientific basis.

Coupons for Scientific Materials and Films

Arrangements for purchases on limited scale of scientific materials and films with the help of UNESCO Coupons, have been finalised. As in the case of Book Coupons, purchasers residing in the country of a member-state of UNESCO which has formally agreed to participate, will pay in national currency and get the Coupons valued in dollars. The selling agencies or the manufacturers of either mate-

rials or films in the participating country will accept the Coupons as payment for the goods to be supplied. These Coupons are designed to avoid difficulties of exchange and import but customs regulations about duties will apply. Two types of Coupons are available, one for use in all countries and the other reserved strictly for purchases in the soft currency countries. For India, the Government have agreed to participate in the scheme and they have received the Coupons for distribution. Applications may be made to Mr. P. N. Kirpal, Dy. Secretary, Ministry of Education, Government of India, New Delhi. The UNESCO office may have some Coupons for supplementing the allotments by the Ministry of Education.

Rare Chemicals

The National Registry of Rare Chemicals, Armour Research Foundation, Illinois Institute of Technology, Technology Centre, Chicago 16, III. (U.S.A.), invites enquiries from scientists in all parts of the world who may want rare chemicals or who can supply them. It is hoped that in future after collecting this information, it may be possible to locate easily and without great delay sources from where rare chemicals could be obtained. Information may kindly be sent to the Science Co-operation Office for South Asia, Delhi, for forward transmission. The Unesco Office undertook in the past the job of procuring rare chemicals for a few scientists, but the experience has shown the need for a central agency to help the research workers.

Students' Seminar at Florence

The World Federation of United Nations Association, Paris, is organising an International Seminar for students at Florence, Italy, from May 22 to June 6, 1950, on the occasion of the fifth general conference of Unesco. The Seminar will be preceded by an art tour in Italy, arranged by the Students' Committee of the Societa Italiana per la Organizzazione Internazionale. The Seminar is intended to give to students interested in international affairs an insight into the work of the UNESCO Conference and thus enable them to appraise the cultural problems claiming the attention of this world organisation. This will also give them an opportunity to observe the technique of a large international conference. Student organisations and other bodies in India who may like to participate in the proposed seminar may correspond direct with

the Secretary-General of the Student Commission, World Federation of United Nations Associations, Education Commission, UNESCO House, 19-Avenue Kleber, Paris 16.

National Archives of India

The records of the Survey of India ranging from 1777 to 1898 formed one of the most important acquisitions of the National Archives of India during the year 1947, according to the *Annual Report of the National Archives* for that year, which has just been published.

Among the most important papers in this collection are: Paper on Astronomical Observations (1789-1828) Lambton and Everest Papers (1801-1825), Du Vernet Records on Himalayan Survey (1841-43, 1843-54) and Journals and Journeys in Tibet 1861. Most interesting from the Indian point of view are the papers relating to Indian Surveyors such as—Papers of Kushal Singh and Ghanashyam Das on Punjab and Kashmir Survey (1809), and particularly the collection of papers relating to Radhanath Sikdar (1849-57) one of the most brilliant Indians to have ever been associated with the survey of India.

The Preservation Branch of the Department has succeeded in rehabilitating 1,56,000 sheets of documents and in treating about 9,400 bound volumes with leather preservative mixture in order to increase their durability and strength. About 4,000 volumes of records were fumigated with thymol spray and paradichlorobenzene as a protective measure against fungi and insects.

The Research Laboratory of the Department continued to carry on experiments with various types of insecticides like DDT and gammexane with a view to determining their suitability for Records Offices and Libraries. Among other investigations undertaken were those on the problem of preserving art paper under tropical conditions. A liberal grant from Government enabled the Department to place orders for several appliances needed by the Research Laboratory and the Preservation Branch including a pH meter for determining the acid contents of the documents sent for repair and a photo-micrographic camera for taking enlarged photos of fungi and insects which infest the records.

The Photographic Section of this Department was enriched by the addition of a microfilm positive printer and an order was placed for the purchase of two more cameras. The Department succeeded in getting microfilmed and enlarged several important manuscripts, among these were a few of Rabindranath Tagore in pencil and some of his earliest writings.

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ANNOUNCEMENT

The schedule of advertisement charges in the **Journal of Scientific and Industrial Research** has now been raised, and the new rates come into force from **August 1949**. The revision will be without prejudice to existing contracts and will take effect after the expiry of the contracted period.

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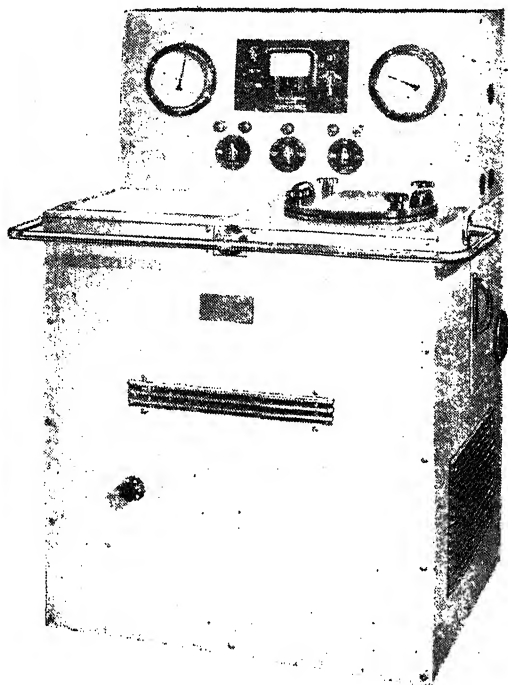
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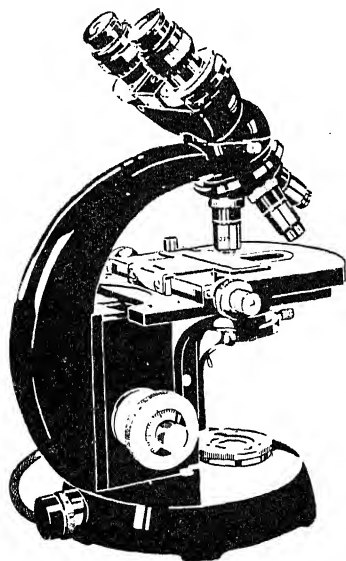
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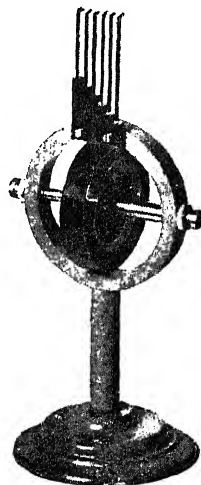
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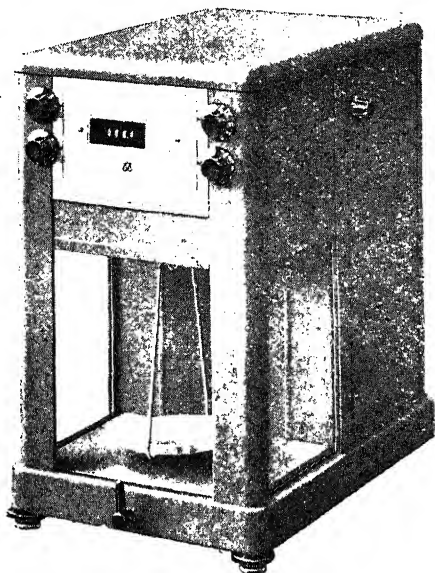
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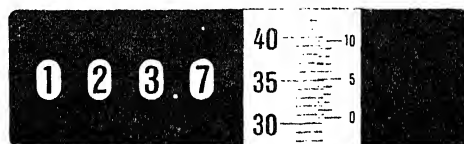
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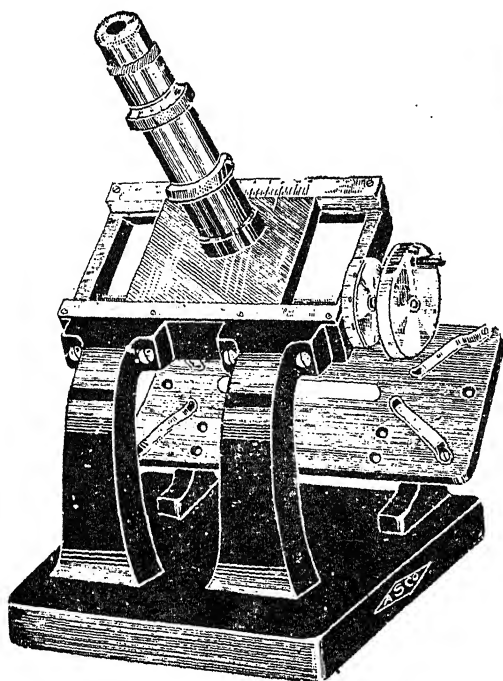
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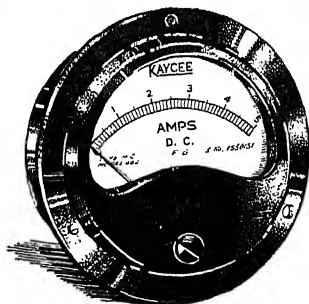
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We have also pleasure in intimating to all our patrons that, at the request of many customers, we are shifting our Offices and Workshop to Visakhapatnam, which is more centrally situated. We request that in future all correspondence to us may be addressed to our new headquarters.

We hope that all our patrons will continue their kind support and encouragement to us, and we, on our part, assure them that we shall spare no effort in serving them to the best of our ability and to the entire satisfaction of all.

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Current Science

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NATIONAL FUEL RESEARCH INSTITUTE, DHANBAD

THE National Fuel Research Institute which was opened by President Rajendra Prasad during the fourth week of April, constitutes the third in the chain of the eleven laboratories sponsored by our farsighted National Government. The creation of the Fuel Research Institute is the fulfilment of the persistent demands made from time to time during the last twenty years, by the three Coal Commissions which considered the position of coal industry in India. It was, however, left to Sir S. S. Bhatnagar to galvanise these recommendations into action and establish the Institute.

The Institute will interest itself with major problems pertaining to fuels in its broadest sense ; the solid, liquid and gaseous fuels will come under its purview and in addition, the Institute will organise a physical and chemical survey of Indian coals, whose deposits in India are none too abundant. This circumstance

calls for an intelligent conservation of our resources with a full and proper appreciation of the growing demands of our present industries and of our future commitments. Our resources of high grade metallurgical coal are limited and so far as our present estimates go, they are expected to last for not more than 50 years. This is a serious situation which calls forth immediate and careful investigation. Our total annual output of all kinds of coal amounts to about 30 million tons, of which a third is consumed by our railways, a fourth is accounted for by metallurgical industries while a tenth of the output is utilised for domestic purposes. It is estimated that about 13 million tons of high grade coal is being used for purposes for which lower grades would suffice.

Processing coal for the recovery of valuable byproducts which provide the raw material for the fine chemical industry, constitutes an important item in the research programme of

the Institute. Sir J. C. Ghosh, who addressed the distinguished gathering on this occasion, disclosed that India imports 2.8 million tons of petroleum products valued at 40 crores of rupees. "Modern research", Sir J. C. Ghosh said, "has shown that it is possible to produce oil from coals of a poorer type, of which we have unlimited resources. Prudence demands that at least 50 per cent. of our petroleum requirements should be secured by the conversion of indigenous coal into oil." Continuing, Sir J. C. Ghosh added that demands for various types of fuel were not static. Even at snail's pace, increased production could be expected to be about one per cent. compound interest annually. And if, as the result of the labour of the Planning Commission, the Government gave the highest priority to the

development of resources, the annual rate of increase might easily be five per cent. compound interest. Hence, research and its utilisation should be planned on the basis of this increased demand. He declared that it would be a mistake to ignore the fact that the environmental climate for applied research in India was not the same as in other countries. He warned the Indian industrialists that mere import of machinery and plant and technical talent from abroad was not all that was necessary for industrialisation of India. In these days of rapid progress, the imported plant and machinery might become obsolete in ten years. More light and better guidance would come as a result of the talented men and women working in these homes of research.

TWO HUNDRED RESEARCH SCHOLARSHIPS INSTITUTED

IN pursuance of the recommendations of the Scientific Manpower Committee, the Ministry of Education, Government of India, have instituted 50 senior and 150 junior research training scholarships in Universities and other educational and research institutions.

Further information about the scheme of research scholarships is given in a statement laid on the table of the House by the Education Minister. The objective of the scheme is to enable deserving and talented students to engage in scientific and industrial research and to acquire, as a result of such training, knowledge and experience for holding research positions.

The scheme provides for two grades of scholarships tenable for a period of three years—senior scholarships of Rs. 200 per month and junior scholarships of Rs. 100 per month.

The Senior scholarships are available for advanced research in basic science and for post-graduate research in engineering and technological subjects. The scholarships are awarded to research workers who have taken at least a Master's Degree in Science or a good

Degree for advanced diploma for engineering or technology.

The Junior scholarships are available for research of comparatively lower standards at post-graduate level, and are awarded generally to those who have taken at least a good Honours Degree in Science or a Degree in Technology.

In the terms and conditions governing the award of the scholarships, it is laid down that the heads of the institutions concerned shall make the award strictly on the basis of merit, subject to the approval of the Government of India. The grants on account of the scholarships will be given to the institutions concerned in quarterly instalments in advance, and the heads of the institutions will disburse the amount to the scholars at the end of every month. It is also laid down that the heads of the institutions will submit quarterly reports on the satisfactory progress of the work of the scholars to the Government of India. The continuance of the scholarships will depend upon the scholars making satisfactory progress with their work.

URANIUM MINERALS OF INDIA*

N. R. SRINIVASAN

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It is known to occur in about 15 minerals in India, some of which have it as the chief constituent while in only a trace is present. It is desirable, therefore, to have knowledge of all the uranium minerals whether of commercial significance or not, because such mineral is found others are not occur nearby.

Primary for geologists to classify these as primary and secondary. Primary are those that have not been changed since they were originally deposited, whereas secondary minerals are formed from the former by physical or natural processes. The primary ones may be different in appearance from the secondary ones which occur far removed from their origin. Primary minerals are usually found in veins or pegmatites. They are dark black, heavy and lustrous. The most common mineral of this class is pitchblende, which is a uranium oxide, which is the source of uranium production in the Belgian Congo and Czechoslovakia. It is frequently found in association with sulphide ores of lead, zinc, nickel and copper. Uraninite which has most of the characteristics of pitchblende but does not occur in quantities except in association with copper. Then, there are the uranium bearing minerals, niobium and titanium, zircon, monazite, euxenite and samarskite which contain small percentages of uranium. These have been worked to a limited extent in some parts of the world.

Secondary uranium minerals are characterized by bright yellow, orange and green colors. They are usually present as powdery masses or groups of small crystals. They may occur in almost any type of rock either alone or with other primary minerals, and have lower percentages of uranium. Carnotite is one such mineral which has become commercially important in some foreign countries as a source of vanadium.

The Government of India have recently announced the discovery in India of deposits of uranium. The new deposits would have to be about 50 miles from those already known to the Atomic Energy Commission. An award of upto Rs. 10 lakhs may be given if in the Government's opinion the deposit is capable of producing 100 tons of uranium in ore.

Uranium and radium. It may be bright yellow brown, grey or pale green depending upon local conditions. Autunite is bright lemon to yellow and invariably fluoresces under ultraviolet light. There are others such as torbernite but these are rare.

OCCURRENCE

The occurrence of uranium minerals in some parts of India has been known as early as 1901.¹ The Geological Survey of India have done the early work in locating uranium deposits although no serious attempt had been made to ascertain the amount of uranium available in this country. The earlier chemical data cannot be relied upon as it has been specifically stated that "the analyses have no claim to great accuracy". During the past five years or so, many investigations have been conducted on the composition and age of uranium minerals, and the results have been reported in Indian Journals. However, there is no compilation which gives ready reference to all the existing sources of uranium in India, and in the following a thorough survey is made of the recorded occurrences of uranium minerals in India.

(1) Pitchblende^{2,3} occurs in a pegmatite which crops out on a hill known as Akbhari Pahar in Gaya District, Bihar, rising 200 feet above the alluvium. The indications on the surface consisted of light yellow uranium ochre and as the pits were deepened, contained nodules of pure pitchblende. It occurs in Pichehli, Gaya District, in the felspar of the pegmatite and assayed to 66.34% of U_3O_8 . It is also known to exist in Dhalbhum District. Prospecting in Bihar did not reveal a very large deposit.

(2) Uraninite⁵ with other uranium minerals has been found in two localities in Singar Zamindari, Gaya District.

(3) Samarskite is known to occur in the Sankara mine, Nellore District, Madras, embedded wholly or partly in felspar, with small books of mica attached to it. It occurs in varying masses from minute crystals to several pounds in weight, although there were no indications of a continuous vein. In addition, Allanite⁷ and two uranium-bearing minerals were also found in the locality. The mineral is also known to occur in Yedur, Bangalore District.⁸

(4) A tantalonibate⁹ of uranyl, iron and rare earths was found 5 miles to the west of

Vaiyampatti, Trichy District. The mineral was probably hatchettolite or endeolite.

(5) A titanoniobate³ of uranyl and rare earths, probably closely allied to euxenite, was found in Erania Taluq, Travancore.

(6) Uranium Ochre³, usually encrusting pitchblende in Gaya District, has been noticed as rounded nodules in the felspar.

(7) Autunite³ occurring as lemon yellow incrustations on some of the minerals, in Gaya District, was found to be less common and not crystalline.

(8) Torbernite³ of bright green colour was found more in the same locality as encrusting mica, apatite and other minerals of the pegmatite and along cleavages in felspar.

(9) Sipylite³ of red brown resinous lustre was detected with samarskite in Sankara mine and also was obtained from Ruzulapad mica mine.

(10) Gummito¹⁰ has been discovered in Ajmer-Merwara, surrounding pitchblende, as red shells.

(11) Uranosphærite¹¹ has been found on the south side of Rewat Hill, Jodhpur.

(12) Uranophane¹⁰ is recently reported to occur in Ajmer.

(13) Thorianite⁹ was found as a perfect crystal in Travancore, and contained a high percentage of uranium oxide.

(14) Tantalite-niobite¹² found near Vaiyampatti when analysed contained uranium. In addition, traces of uranium are always found in monazite which might also be extracted by suitable methods.

Though these are the occurrences reported in literature, the Director, Geological Survey of India, observed as early as 1914 that "there seems to be no reason why uranium minerals should not be found at depths". With the impetus given in recent years by the atomic energy program, newer technique and instruments for prospecting have been evolved. These are described admirably in many governmental publications,¹³⁻¹⁵ reference to which may also be made by Indian prospectors.

1. *Memoirs, G.S.I.* 1931, **34**, 31. 2. *Records, G.S.I.*, 1914, **44**, 24. 3. *Ibid.*, 1919, **50**, 255. 4. *Ibid.*, 1921, **53**, 297. 5. *Ibid.*, 1921, **52**, 308. 6. *Ibid.*, 1911, **41**, 210. 7. *Ibid.*, 1920, **51**, 210. 8. *Ibid.*, 1930, **64**, 424. 9. *Ibid.*, 1917, **48**, 8. 10. *Jour. Sci. Ind. Res.*, 1948, **7**, 35. 11. *Records, G.S.I.*, 1922, **54**, 36. 12. *Ibid.*, 1918, **48**, 8. 13. "Prospecting for Uranium," by the United States Atomic Energy Commission and the United States Geological Survey, 1949. 14. "Guide to Prospectors," by His Majesty's Stationery Office, London, 1949. 15. "Radioactive Mineral Deposits," by Bureau of Mineral Resources, Geology and Geophysics, Australia, 1948.

SYMPOSIUM ON THE HISTORY OF SCIENCE IN S. ASIA

THE Council of the National Institute of Sciences of India, in collaboration with the UNESCO South Asia Science Co-operation Office, propose to hold this winter in Delhi a Symposium on the History of Science in South Asia. It is expected that Dr. J. Needham, F.R.S., who is at present engaged in the writing of a History of Science in China, may come to India to participate in the Symposium.

It is proposed to constitute a study group for the Symposium with 15 scholars from within India and the adjacent countries, which will hold consecutive sessions for 3-4 days, where each scholar will present a paper on a specified subject, which will be discussed with particular reference to the impact of scientific knowledge on the problems of social organisation and human civilisation in general.

The following tentative agenda has been

drawn up in order to give an idea of the scope of the Symposium which will cover the period up to the end of the 18th century.

1. (a) Chronology of the achievements; (b) Defining the periods of achievements;
2. Life stories of the pioneers;
3. Contacts with outside on countries' own initiative or by the adventurous trips of foreigners;
4. General history of those periods with stress on social conditions;
5. Impact of the discoveries of the scientists on military strategy of the kings and on the general living conditions like town planning, public health, agriculture, transport and industries.

Both historians and scientists are welcome to take part in the Symposium as it is expected that they will supplement each other's work and study.

THE CUDDAPAH IGNEOUS ACTIVITY

V. S. DUBEY

(Benares Hindu University)

THE author read a paper at the Indian Science Congress at Patna, in 1948, in which the view was expressed that the trap occurring in Delhi Series near Bayana was the same as the Gwalior trap; and the Erinpura granite, being post-Delhi, was of the same age as the other acid rocks of late Bijawar period of Sone Valley, and these were intruded at the end of the Cuddapah period. Recently an interesting paper has been published by Prof. A. Holmes in the Geological Magazine, Sept.-Oct. 1949, in which the age of uranite occurring in the post-Delhi pegmatites of Rajputana, which are associated with Erinpura granite, has been determined by radioactive method. The age determined amounts to 735 million years and this now definitely confirms the view expressed by the writer¹ that the Erinpura granites were intruded at the end of the Cuddapah period. For the last three years the writer, with the help of his research students, has been carrying on field studies on the geology of the Bijawars of Sone Valley and of Bundelkhand. This has considerably clarified the views on the igneous cycle of the Cuddapah age.

The conclusions arrived at as a result of this study are that the Cuddapahs can be divided into three parts: Lower, Middle and Upper. The Lower period was without any kind of igneous activity. In the Middle period there was vast igneous activity as a result of which several thousand feet of basic lavas were poured out in Central and Southern India. The basalts of this age are found wherever the Cuddapahs or their equivalents are exposed. After this, came the intrusion of the ultrabasic rocks, which are the source* of diamonds. After this, at the end of Upper Cuddapah period came very thick flows of acid tuffs and rhyolites, and intrusions of granophyres, felsites, and granites.

* Near Panna, a diamondiferous kimberlite plug has been located. In the Sone Valley a large amount of ultrabasic rocks of this age intruding the basalts have been studied by the writer. It is highly probable that these ultrabasic rocks also occur in Hyderabad State and Sambalpur area in Orissa where they have been the source of diamonds occurring in these areas. But they still remain to be located and will be of great economic importance.

In Sone Valley, besides the extensive development of acid tuffs, there are big intrusions of granophyres and flows of rhyolites. In Bundelkhand also the acid tuffs have been found. According to the writer, these acid flows and intrusions of the Sone Valley and Bundelkhand are contemporaneous with the Erinpura granites of Rajputana. In Bundelkhand and Sone Valley what has been called as Lower Vindhyan such as Samri Series really belongs to the Upper Cuddapahs, and in Rajputana also, some of the formations referred to as Lower Vindhyan correspond to the Upper Cuddapahs and the Malani rhyolites and the rhyolites of Sone Valley and Bundelkhand are of the same age. The granites of Jalor and Siwana are almost of the same age as these other acid rocks. All these acid flows and intrusions mark the end of the Upper Cuddapah igneous activity accompanied by heavy folding. Thus the igneous cycle is clear and complete.

The age of the acid intrusions of post-Delhi period corresponding to Erinpura granite has been estimated to be about 735 million years by Prof. Holmes. The basalts are slightly older and in Sone Valley a few thousand feet of quartzites intervene between the basaltic flows and acid tuffs. So the age of these Bijawar basalts may be somewhere about 800 million years. The Radium-helium method used by the writer² gave the age of 500 million years for these Gwalior basalts. From the exact determination made by the uranium lead method now it appears that about 30-40% of helium might have escaped from these basalts. As regards the age of the beginning of the Cuddapahs, it will be somewhere between 800 and 900 million years. This corresponds to a lead ratio of about 0.11 which has been taken by Prof. Holmes as the lower limit of the Upper pre-Cambrian in the different parts of the world. Thus in India, in the Sone Valley, in the Sameri Series of Bundelkhand, and in Rajputana, the age of these granites and acid flows marking the end of the Cuddapahs can now be fixed as the end of the Upper pre-Cambrian. The writer is of the opinion that there may be several areas in Northern India where the granites and other acid rocks of this age occur but which have not been differentiated from the other older granites like Bundelkhand. In Bundelkhand the acid tuff flows are definitely

much later than the Bundelkhand granite, and in Sone Valley these granophyres are of slightly later age than the basic Gwalior lavas, being much later than the Bundelkhand granite.

The detailed study of the Bijawars of Sone Valley and of Bundelkhand and of other areas

in Northern India will shortly be published in detail.

1. Dubey, V. S., and Pathak, B. D., *Proc. Ind. Sci. Congress*, Patna, 1948. 2. Holmes, The age of the earth (*Bull. Nat. Res. Council U.S.A.*), 1931. p. 415.

WHO ON THE USE OF STREPTOMYCIN

THE Standing Technical Committee of the Tuberculosis Association of India have resolved that the following recommendations of the Expert Committee of the World Health Organization on the use of Streptomycin be adopted in India :—

Streptomycin, while being useful in the treatment of several forms of tuberculosis, is, at its best, only a part of the general treatment in most forms of the disease and is partially dependent for its full effect upon other more common therapeutic measures, such as bed rest, pneumothorax or chest surgery. It is generally known that even under the best therapeutic conditions, severe toxic manifestations occur, some of them fairly frequently. Furthermore, tubercle bacilli in certain patients acquire resistance to streptomycin which eventually necessitates termination of specific therapy. It was, therefore, recommended that during the initial period of study and use streptomycin should be distributed by governments only to institutions and medical centres regularly concerned with the diagnosis and treatment of tuberculosis. With such safeguards, limited supplies will be beneficially employed under the supervision of physicians experienced in streptomycin therapy, aware of its dangers and contra-indications and prepared to carry on further research on the more precise use of this and other newly developed antibiotics against tuberculosis.

Type of Cases Suitable for Treatment. Streptomycin was not found to be suitable for all types and stages of tuberculosis infections.

It was unanimously agreed that patients with tuberculous meningitis and generalized hematogenous or miliary tuberculosis should be given prior consideration, because of the extremely high mortality-rate among untreated cases and the lack of any other dependable therapeutic approach.

It appeared that fulminating types of bronchopneumonic pulmonary tuberculosis of recent origin, which have not progressed beyond the possibility of healing, may frequently be ameliorated by streptomycin; residual

lesions of a more chronic and destructive character may require other forms of treatment.

Some of the most distressing complications of pulmonary tuberculosis, especially tuberculous laryngitis and tuberculous enteritis, may be greatly benefited symptomatically by appropriate streptomycin treatment.

Finally, streptomycin was found to be particularly effective in the treatment of tuberculous sinuses and fistulae; less favourable results have so far been reported in renal tuberculosis and in tuberculosis of bones, joints and glands.

Regimens of Treatment.—Optimum streptomycin regimens for the different forms of tuberculosis have not been determined with sufficient precision to make exact recommendations possible at this time. At the present stage of knowledge, the medical practitioner cannot expect to be provided with a universally accepted formula, but will have to make his own choice from several regimens recommended by various research workers. The group of experts could therefore hardly do more than define certain general principles to be observed in the application of streptomycin therapy. Thus, it was suggested, among other things, that in certain cases when the disease changes for the worse or when a relapse occurs, a subsequent or second course of streptomycin may be indicated, provided that the tubercle bacilli have not become predominantly streptomycin-resistant. The indications for a second course of treatment cannot, in the present state of knowledge, be specified precisely, but must be determined after careful review of all clinical and laboratory data in each case. There was, in the opinion of the group, some evidence that combined therapy (streptomycin plus sulphone derivatives or para-aminosalicylic acid) may be more effective in some forms of tuberculosis than either drugs used alone. At the present time, combined therapy shows greatest promise in the treatment of miliary tuberculosis and tuberculous meningitis.

ROOM ACOUSTICS AND ULTRASONICS

DR. R. N. GHOSH, in his Presidential Address to the Physics Section of the 37th Indian Science Congress, held at Poona, referred to the important contributions made by Prof. Sir C. V. Raman to the field of sonics and ultrasonics. In this connection, he made particular mention of the theory of vibrations of bowed strings, impact of pianoforte hammer, the harmonic contents of tabala and the discovery of the laws of diffraction of ultrasonic waves. Further, he briefly discussed the mechanism of ultrasonic absorption by liquids and stressed the fact that in the liquid state the major portion of the absorption of ultrasonic energy, which is quantised, is due to its semi-crystalline structure.

The major portion of the address was devoted to Room Acoustics. Starting from the fundamental experimental investigations of Sabine, Dr. Ghosh traced several inadequacies of the geometrical theories. The wave approach, which takes into account the phenomenon of room resonances, was briefly outlined. He derived the expressions for the characteristic frequencies of rectangular room and wave damping coefficient and showed that the decay rate would be different for different modes of vibration, viz., axial, tangential and oblique. He then discussed the case of a rectangular room with uniform distribution of

absorbing material, driven at a known frequency by a source situated at a corner of the room and arrived at the expression for the average pressure at a point and compared it with Sabine's statistical result. He pointed out the difference, which consists in the value of absorption coefficient used. He added that the problem of non-uniform distribution of absorbing material in a rectangular room could be solved by (1) the method of successive approximations, (2) Fourier expansions, and (3) the application of Dirac's δ -function. In this connection he brought out the fact that a piece of absorbing material produces most effective absorption when located at a place where most of the wave functions have their maxima, which in the case of a rectangular room happens to be the corners and edges. Next he mentioned about the work of Morse and Bolt in connection with the application of Dirac's δ -function to the problem of ergodic motion and the Index of Randomness. The accurate methods of the measurement of Acoustic impedance were then described.

Finally, before concluding the address, Dr. Ghosh drew attention to the important aspect of design and manufacture of Acoustical Apparatus in India and mentioned about the lead given by Bhatt and his associates in this direction.

REWARDS FOR DISCOVERY OF URANIUM AND BERYL ORES

REWARDS for the discovery in India of deposits of Uranium ore and Beryl ore are to be granted by the Government of India. In the case of Uranium, the new deposits would have to be not less than 100 miles, and in the case of Beryl, 50 miles from any other deposits of these ores the existence of which is already known to the Indian Atomic Energy Commission. Government reserves the right to determine whether a particular discovery is the first from a particular location.

An award of up to Rs. 10,000 may be given if, in Government's opinion, a new deposit is capable of producing 100 tons of Uranium oxide in ore, assaying not less than 0.4% U_3O_8 . A similar discovery capable of producing 100 tons of Beryl assaying not less than 12% BeO , or other Beryllium mineral in proportionate amount, may earn an award of up to Rs. 2,000.

Should new deposits of both ores, though not sufficient to be of economic importance in themselves, justify prospecting in the

neighbourhood for further deposits, Government may grant funds for this purpose. Grants-in aid for mine development are available to applicants who produce and deliver not less than 20 tons of Uranium ore and 50 tons of Beryl ore from a concession or mining lease not previously worked for these ores.

In order to help prospectors, the Atomic Energy Commission will make without charge tests of samples submitted; and where necessary, further chemical and field tests for determination of ores.

Applications for rewards should be addressed to the Secretary, Atomic Energy Commission, Central Secretariat, North Block, New Delhi. Further details are available in the *Gazette of India* of April 15, 1950.

Officers or other employees of the Government of India, including employees of the Atomic Energy Commission, shall not be eligible for these rewards.

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ON THE SCATTERING OF FAST
ELECTRONS

THE scattering formula for fast electrons using Dirac's relativistic equations has been deduced by Mott (1929)¹. His calculations become difficult owing to the necessity of solving Dirac's equations for the electron in a Coulomb field. The solutions in this case are in the form of infinite series. The scattered function obtained from the asymptotic expansion of these solutions cannot be summed. Hence an approximate formula for the scattered intensity is obtained in a round about way. By regarding the electrostatic interaction as small, the first approximation of the scattered intensity (Born's approximation) can, however, be obtained in a much simpler way.

A beam of fast electrons is incident on a nucleus. The differential cross-section for scattering is given by (*vide* Heitler²)

$$d\phi = \frac{2\pi}{\hbar v} |H'|^2 p_f \quad (1)$$

where v is the velocity of the incident electron, $p_f dE$ is the number of final states of the

system within an energy interval E and $E + dE$. The matrix element

$$H' = \int \psi_a^* V \psi_b d\tau \quad (2)$$

where $V = -\frac{ze^2}{r}$. Following Born's approximation we shall substitute plane waves for ψ_a and ψ_b , the wave functions for the incident and scattered electron. This procedure is valid if the energy of the incident particles is much greater than the ionisation energy. This condition may be written in the form

$$\frac{ze^2}{\hbar v} \ll 1$$

which evidently is always satisfied for the velocity of the incident particle in the relativistic region except for the heaviest elements

(even then $\frac{ze^2}{\hbar v} < 1$).

Using relativistic wave-functions for free electron we have,

$$\psi_a = u_a(s) e^{\frac{i}{\hbar c} (\vec{p}_a \cdot \vec{r})}, \quad \psi_b = u_b(s) e^{\frac{i}{\hbar c} (\vec{p}_b \cdot \vec{r})} \quad (3)$$

where p_a and p_b are expressed in energy units, i.e., c multiplied by momentum and $u(s)$'s are

the well-known Dirac amplitudes. Since the integration in (2) includes summation over the spin variables, we get

$$H' = \frac{Ze^2 \cdot 4\pi\hbar^2 c^2}{|p_a - p_b|^2} u_a^* u_b \quad (4)$$

In this case, (m being the total mass of the electron),

$$\rho_K = \frac{m^2 v d \Omega}{(2\pi\hbar)^3}$$

$$\text{and } |p_a - p_b|^2 = 4p^2 \sin^2 \frac{\theta}{2}$$

Thus we have from (1) and (4)

$$d\phi = \left(\frac{Ze^2}{2m_0 v^2} \right)^2 \left(1 - \frac{v^2}{c^2} \right) \text{cosec}^4 \frac{\theta}{2} |u_a^* u_b|^2 d\Omega \quad (5)$$

Now for a particular spin direction in the initial state, we have two different possible spin directions in the final state. These transitions we represent by $\uparrow\uparrow$ and $\uparrow\downarrow$. Corresponding to the opposite spin direction in the initial state there are again two possible transitions which we represent by $\downarrow\uparrow$, $\downarrow\downarrow$. The values of $u_a^* u_b$ for these four cases can be easily calculated from the well-known values of $u(s)$'s (vide Heitler², p. 86). In this case for the initial electron $p_x = p_y = 0$ and $p_z = p$ and for the final electron $p_y = 0$, $p_x = p \sin \theta$, and $p_z = p \cos \theta$. With these we at once get,

$$u_a^* u_b = \left(1 + \frac{p^2 \cos \theta}{(\mu + E)^2} \right) \left(1 + \frac{p^2}{(\mu + E)^2} \right)^{-1} \quad \text{for } \uparrow\uparrow \text{ transition} \\ = \frac{p^2 \sin \theta}{(\mu + E)^2} \left(1 + \frac{p^2}{(\mu + E)^2} \right)^{-1} \quad \text{for } \uparrow\downarrow \text{ transition} \quad (6)$$

For $\downarrow\downarrow$ and $\downarrow\uparrow$ transitions $u_a^* u_b$ is same as in $\uparrow\uparrow$ and $\uparrow\downarrow$ transitions respectively. To get the total cross section for scattering we shall have to sum (5) over both spin directions in the final state. Thus squaring and adding we get from (6)

$$\Sigma |u_a^* u_b|^2 = \left(1 + \frac{v^2}{c^2} \sin^2 \frac{\theta}{2} \right) \quad (7)$$

Averaging over the initial spin directions keeps (7) unaltered. Thus we get for the total differential cross section

$$d\phi = \left(\frac{Ze^2}{2m_0 v^2} \right)^2 \left(1 - \frac{v^2}{c^2} \right) \text{cosec}^4 \frac{\theta}{2} \left(1 + \frac{v^2}{c^2} \sin^2 \frac{\theta}{2} \right) d\Omega \quad (8)$$

This agrees with the first approximation of Mott's formula.

Mott has however pushed his calculations a stage further and obtained a higher approximation term as well.

In the method used here we can proceed to higher approximation only by using the idea

of intermediate states, which will be difficult. Hence the higher approximation terms cannot be obtained.

We wish to express our grateful thanks to Prof. K. C. Kar, D.Sc., for his kind interest and encouragement.

Physical Laboratory,
Presidency College,
Calcutta,
February 21, 1950.

S. SEN GUPTA.

P. P. CHATTARJI.

1. Mott, *Proc. Roy. Soc.*, 1929, A, 124, 425. 2. Heitler, *Quantum theory of radiation*, 1949.

UNSTABLE PENDANT DROPS IN RELATION TO DROP-WEIGHT METHOD OF SURFACE TENSION

WORKING from the original Harkins and Brown drop-weight method of surface tension determination, Brown and McCormick¹ have shown, by dimensional analysis, that when drops are similar in shape at the unstable stage, equal fractions of the whole drop become detached, and that if the usual flat tip of a definite radius (as in Harkins and Brown method) is replaced by an inverted cone all unstable drops hanging from such a cone are similar in shape.

On the above considerations a practical conical tip method has been developed by them for determination of surface tension of a liquid by comparison with a standard liquid of known surface tension, in which no correction factors inherent in Harkins and Brown method are involved. The equation worked out theoretically by Brown and McCormick for their new method is

$$\frac{\gamma_1}{\gamma_2} = \left(\frac{m_1}{m_2} \right)^{2/3} \left(\frac{\rho_1}{\rho_2} \right)^{1/3} \quad (1)$$

where γ , m , and ρ are surface tension, mass of single drop, and density respectively of the liquid and the subscripts 1 and 2 refer to the two different liquids with similar drops for comparison, one being of known γ ; the quantities m and ρ being measurable for both the liquids.

It is shown possible here to obtain the above relation of Brown and McCormick independently from altogether different considerations given by one of the authors (K.G.P.) in a recent note² in which he has derived an equation

$$\frac{\gamma_1}{\gamma_2} = \frac{\sigma_1}{\sigma_2} \cdot \frac{de_1}{dc_2} \quad (2)$$

for pendant drops in an unstable stage for two liquids 1 and 2, the quantities γ and σ repre-

senting surface tension and density of the liquids respectively, and d_e , the equatorial diameter of their drops under similar conditions. This equation is assumed to involve the stage of instability postulated by Brown and McCormick.

Now for similar drops of two liquids 1 and 2 having the radii of curvatures b_1 and b_2 at the apex, and the volumes V_1 and V_2 , the ratio of the equatorial diameters d_{e1} and d_{e2} respectively is given by

$$\frac{d_{e1}}{d_{e2}} = \frac{b_1}{b_2} = \frac{V_1^{1/3}}{V_2^{1/3}} \quad (3)$$

$$\text{or } \frac{d_{e1}^2}{d_{e2}^2} = \frac{V_1^{2/3}}{V_2^{2/3}} \quad (4)$$

Using the above relation, equation (2) becomes

$$\frac{\gamma_1}{\gamma_2} = \frac{\sigma_1}{\sigma_2} \cdot \frac{V_1^{2/3}}{V_2^{2/3}} \quad (5)$$

If with the above exact relation, the assumption of Brown and McCormick that the volumes V' of the detached portions of the drops at the stage of instability being the constant fractions of their volumes V in unstable stage, is taken to be valid, the equation (5) above becomes

$$\frac{\gamma_1}{\gamma_2} = \frac{\sigma_1}{\sigma_2} \cdot \frac{V_1'^{2/3}}{V_2'^{2/3}} \quad (6)$$

Introducing the mass quantities, we get

$$\begin{aligned} \frac{\gamma_1}{\gamma_2} &= \frac{\sigma_1}{\sigma_2} \cdot \frac{\left(\frac{m_1}{\sigma_1}\right)^{2/3}}{\left(\frac{m_2}{\sigma_2}\right)^{2/3}} \\ &= \left(\frac{m_1}{m_2}\right)^{2/3} \left(\frac{\sigma_1}{\sigma_2}\right)^{1/3} \end{aligned} \quad (7)$$

which is the same result as equation (1) above of Brown and McCormick for conical tip. It would be interesting to test how far the unstable pendant drops obey the above relation. This point is under investigation in these laboratories.

Physics Laboratory, N. R. TAWDE.
The Institute of Science, K. G. PARVATIKAR.
Bombay,
April 9, 1950.

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A NEW ULTRASONIC METHOD FOR DETERMINING ELASTIC CONSTANTS

IT is very well known that the breadth of resonance for a piezoelectric plate excited at one of its natural frequencies, is wide enough to allow the excitation of the crystal with suffi-

cient power throughout a considerable frequency range. The author employs this broad frequency region of vibrations in the neighbourhood of one of its natural frequencies as the continuous source for finding transmission maxima through a crystal whose elastic constants are to be determined.

An X-cut quartz plate of thickness 2 mm., silvered on both sides, is made to excite vibrations in a thick plate of a crystal whose fundamental must be of the order of 0.1 to 0.3 Mc/sec. and the ultrasonic wave transmitted by the crystal is communicated into a liquid contained in a glass trough. The diffraction pattern of the ultrasonic grating set up in this liquid is seen with the usual arrangement. When the frequency of the oscillator is varied continuously in the region of one of the natural frequencies of the piezoelectric plate, it is found that the diffraction pattern due to the ultrasonic wave transmitted by the crystal exhibits a series of sharp maxima which are close to each other. Each of these transmission maxima corresponds to the excitation of one of the harmonics of the longitudinal vibrations of the crystal block and the differences between the successive maxima are found to be identical, corresponding very nearly to the longitudinal fundamental of the crystal plate. Such transmission maxima are observed in the neighbourhood of all the natural frequencies of the piezoelectric plate. More number of these transmission maxima are observed in the lower frequency region and with higher powers of the oscillator. Using the longitudinal fundamental frequency of the crystal thus determined and the thickness of the crystal, the longitudinal velocity and hence the effective elastic constant in the particular direction is calculated with the help of the familiar formulæ. With this type of set-up it is found that the shear modes do not come up prominently. This is also one of the difficulties sometimes encountered in the wedge method developed by Bhagavantam and Bhimasenachar.¹ To overcome this difficulty the author employed a Y-cut quartz plate for determining velocities of shear modes. In place of the X-cut quartz plate, a Y-cut quartz plate is cemented to the crystal and the transmission maxima studied as in the previous case. It is now found that the shear modes are excited more prominently than the longitudinal ones. From transmission maxima thus observed, the shear modes are easily sorted out and the corresponding fundamental frequency determined taking note of their high intensity. The velocity and the

elastic constant for shear wave, in the particular direction, is then calculated in the usual manner.

Using this method the author has determined the elastic constants of potash alum employing crystals of thickness about 1 cm. The values for the elastic constants thus obtained are given in the following table along with those reported earlier.

	C_{11}	C_{12}	C_{44}
Author ..	2.56	1.07	0.85
Voigt ² ..	2.43	1.009	0.843
R. V. G. Sundara Rao ³ ..	2.56	1.07	0.86
Bhagavantam and B. R. Rao ⁴ ..	2.54	1.07	0.84

This method has the main advantage that employing a Y-cut plate shear modes are excited in any crystal with ease. Further, higher accuracy in determination of elastic constants is attained in this method because of the large thickness of the crystal used and the increased number of transmission maxima obtained with moderate powers of the oscillator. On the other hand, the method has the drawback that it requires a crystal block of thickness of the order of 1 to 1.5 cm. and is not suitable for crystals available only in very small sizes. It is also found that there is a definite size effect on the vibrations of the crystals which is being investigated in detail.

The author wishes to express his grateful thanks to Professor C. Mahadevan for giving facilities in his Laboratory.

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Geophysical Laboratory,
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March 24, 1950.

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CHROMATOGRAPHIC SEPARATION OF DYES

RUGGLI AND JENSEN have separated mixtures of direct, basic and acid dyes from an aqueous solution using alumina as adsorbent and have traced certain relationships between the constitution of azo dyes and their adsorbability.¹ Cellulose in the form of filter-paper is of

exceptional interest in chromatography and has been extensively studied in recent years, although there has been little application to dyes. One advantage of this method is that the chromatogram is well adapted to visual examination and can be filed after drying for future reference.² The technique of paper chromatography for dyestuffs is essentially a refinement of Schönbein's "capillary analysis".³ A convenient procedure is to dip a rectangular filter-paper with a short stem in the middle in the dyestuff solution (a few c.c. in a glass dish); after a few minutes the dyestuff solution is replaced by a solvent. Draughts are avoided by having the set-up inside a balance case provided with some arrangement (such as double lengths of thin wire or string) for supporting a series of paper strips. The method is useful for acid dyes which separate into sharp and definite bands; e.g., a mixture of the four acid dyes, Naphthol Green B, Tartrazine NS, Solway Blue BS and Orange II can be separated, water being used for adsorption and development.

Basic and direct dyes do not separate into sharp bands from an aqueous or dilute acetic acid solution; but clear separations can be effected when a 1:4 mixture of water and methyl cellosolve acetate is used for adsorption and development. Thus the following mixtures have been separated: (a) Methylene Blue, Safranin and Auramine O; (b) Chrysophenine CH, Congo Red, and Chlorazol Sky Blue FFS. Auramine O is more strongly adsorbed than Brilliant Green in contrast to their behaviour on alumina.¹ Ruggli and Jensen were unable to separate a mixture of Auramine O and Malachite Green; these have now been separated on paper using pyridine as solvent for adsorption and development, and subsequently exposing the paper to hydrochloric acid vapours. Chromatography of an ether or dioxane solution of the mixture after basification also separates Auramine O from Malachite Green.

A good separation of direct dyes can be obtained on cellulose acetate, nylon or vinyon fabric after suitable activation, e.g., by treatment with *n*-butanol.⁴ When two drops of an aqueous solution of the mixture are placed in the centre of the fabric, held taut in an embroidery ring, and a few drops of water are used for development, a clear separation of a mixture of Chrysophenine CH, Congo Red and Durazol Fast Blue 8GS is obtained.

The adsorption of azo dyes on paper generally runs parallel to the number of azo groups

present; the more the number of azo groups, the stronger the adsorption.¹ However, the affinity of the dye for cellulose and other factors plays an important part. Thus a substantive monoazo dye (Direct Fast Yellow FF; a dehydrothiitoluidine derivative) is more strongly adsorbed than a non-substantive disazo dye (Cloth Fast Black B, an acid dye). Disazo dyes of the type ($A_1 \rightarrow Z \leftarrow A_2$) in which at least one of the two diazonium components, A_1 or A_2 , contains a nitro group are weakly adsorbed; thus Naphthol Blue Black B (p -
 $\xrightarrow{\text{alk.}} \text{Nitroniline} \xrightarrow{\text{acid}} \text{H-acid} \xleftarrow{\text{alk.}} \text{Aniline}$) is less strongly adsorbed than the monoazo acid dyes, Fast Red A and Orange II; the trisazo dye Chlorazol Green BNS (Phenol \leftarrow Benzidine
 $\xrightarrow{\text{alk.}} \text{H-acid} \xleftarrow{\text{acid}} p\text{-Nitraniline}$) is less strongly adsorbed than the disazo dyes, Chlorazol Sky Blue FF and Benzopurine 4B. The influence of a hydroxyl group not chelated with an azo group in promoting adsorption on alumina has been shown earlier by the observation that 4-benzeneazoresorcinol is more strongly adsorbed than 2:4 or 4:6-bisbenzeneazoresorcinol.⁵ Neolan Red B (a chromium complex) is more weakly adsorbed than the parent azo dye, Eriochrome Red B. The solvent sometimes determines the order of separation; Benzopurpurine 4B is more strongly adsorbed than either Chlorazol Sky Blue FF or Durazol Fast Blue 8GS on filter-paper using water as solvent, but the order is reversed when aqueous methyl cellosolve acetate is used as the solvent.

Our thanks are due to the Council of Scientific and Industrial Research under whose auspices this work has been carried out. Details will be communicated to the *Journal of Scientific and Industrial Research*.

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VARIATION OF DIELECTRIC CONSTANT WITH CONCENTRATION

THE observed linear variation of dielectric constant¹⁻³ with concentration in dilute solutions of nonpolar solvents can be directly

derived from the Debye-Clausius-Mosotti equation as follows:—

$$\frac{(\epsilon_{12} - 1)}{(\epsilon_{12} + 2)} V_{12} = p_1 + (p_2 - p_1) \omega_2 \quad (1),$$

with the usual notations. Substituting the observed relation $V_{12} = V_1 + \beta \omega_2$ in (1) and solving for ϵ_{12} ,

$$\begin{aligned} \epsilon_{12} &= 1 + 3 \left\{ \frac{p_1 + (p_2 - p_1) \omega_2}{(V_1 - p_1) - (p_2 - p_1 - \beta) \omega_2} \right\} \\ &= \epsilon_1 + \frac{3}{(V_1 - p_1)} \left[\left\{ (p_2 - p_1) + \left(\frac{p_2 - p_1 - \beta}{V_1 - p_1} \right) p_1 \right\} \omega_2 \right. \\ &\quad \left. + \left\{ (p_2 - p_1) + \left(\frac{p_2 - p_1 - \beta}{V_1 - p_1} \right) p_1 \right\} \left(\frac{p_2 - p_1 - \beta}{V_1 - p_1} \right) \omega_2^2 + \dots \right. \\ &\quad \left. + \left\{ (p_2 - p_1) + \left(\frac{p_2 - p_1 - \beta}{V_1 - p_1} \right) p_1 \right\} \times \left(\frac{p_2 - p_1 - \beta}{V_1 - p_1} \right)^{n-1} \omega_2^n + \dots \text{to } \infty \right\} \quad (2) \end{aligned}$$

Since $\omega_2 \ll 1$ in dilute solutions,

$$\epsilon_{12} = \epsilon_1 + \frac{3}{(V_1 - p_1)} \left\{ (p_2 - p_1) + \left(\frac{p_2 - p_1 - \beta}{V_1 - p_1} \right) p_1 \right\} \omega_2 \quad (3)$$

as compared with the observed relation $\epsilon_{12} = \epsilon_1 + \alpha \omega_2$

whence

$$\alpha = \frac{3}{(V_1 - p_1)} \left\{ (p_2 - p_1) + \left(\frac{p_2 - p_1 - \beta}{V_1 - p_1} \right) p_1 \right\}$$

or

$$p_2 = \frac{3\alpha V_1}{(\epsilon_1 + 2)} + (V_1 + \beta) \frac{(\epsilon_1 - 1)}{(\epsilon_1 + 2)},$$

which is identical with the expression derived by Halverstadt and Kumler³ for $p_2(\infty)$.

Equation (2) indicates that in the case of highly polar solutes ($p_2 > p_1$) terms in the higher powers of ω_2 cannot be ignored even when ω_2 is small. Consequently in such cases, even for dilute solutions the $\epsilon_{12} - \omega_2$ plot should be a curve concave upwards. This indeed is the case for dilute solutions of nitrobenzene in non-polar solvents where the variation of ϵ_{12} with ω_2 follows the relationship $\epsilon_{12} = \epsilon_1 + \alpha \omega_2 + \alpha' \omega_2^2$ as observed by Smith and Cleverdon.⁴

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 April 12, 1950.

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THE TRANSPIROSCOPE* A NEW DEVICE

THE transpiroscope (text figs. 1 and 2) consists of a chamber with a metal-loop-handle at the top and an air-tight lid hinged sideways. The bottom and the lid are each provided with a glass panel. A human-hair clock-type hygrometer is located in the chamber towards the top-end. There is a groove on the right side for a safe lie of the leaf petiole. Near the top is a hole for introducing a thermometer.

With the lid of the chamber kept open, the humidity of the atmosphere is read directly on the dial of the hygrometer. The experimental leaf is then introduced *in situ* into the chamber and the lid closed over it in such a manner that the petiole lies safe on a pad of cotton wool in the side-groove. A fixed period (usually 5 minutes) is allowed for one observation. The rise in humidity (due to the water of transpiration being given off as vapour) is indicated by the movement of the needle of the hygrometer. The difference between the readings gives the transpiration value, which is then reduced to a unit value per square centimeter of the leaf area for purposes of comparison. Such determinational studies

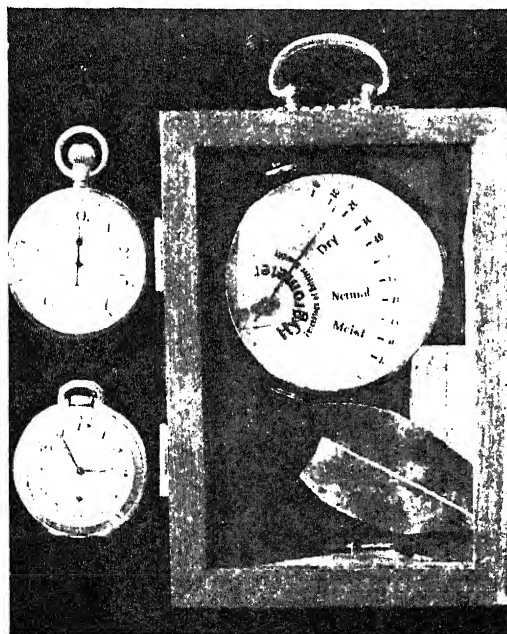


FIG. 1. A photograph of the transpiroscope at the start of an experiment at 2-55 P. M. with a *citrus* leaf *in situ* enclosed inside the chamber. Note the reading. ($\times 1/3$).

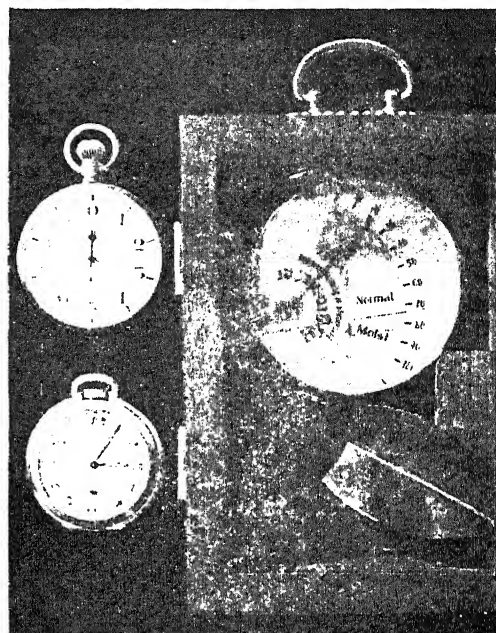


FIG. 2. The photograph of the same arrangement after expiry of ten minutes at 3-5 P. M. Note the reading now. The difference between the two readings indicates the transpiration value in terms of humidity. ($\times 1/3$).

of transpiration can be made with ease on at least 8 leaves *in situ* per hour under natural field conditions without any elaborate arrangement. The apparatus has been found to be very portable.

My grateful thanks are due to Professor T. C. N. Singh who tested the apparatus both under laboratory and field conditions.

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December 1, 1948.

* This apparatus was devised by the author in 1940 in connection with her investigation on the comparative transpiration values of the various species of *Citrus* in the Central Provinces.

PUCCINIA KUEHNII (KRUEG.) BUTLER ON SUGARCANE IN INDIA

THE immunity of the Indian sugarcane to *Puccinia kuehnii* (Krueg.) Butler was doubted by Butler (1918). Although there is no published record to support his contention, specimens deposited in Herb. Crypt. Ind. Orient show that this fungus was collected on *S. officinarum* in 1919 from Almora, and from

Pusa in 1926. Recently, specimens of sugarcane received for examination from Kopergaon, Ahmadnagar, Bombay showed severe infection of this fungus on leaves of sugarcane variety Co. 475. It has also been recorded in Australia, Ceylon, China, Fiji, Formosa, Indo-China, Japan, Java, Sumatra, Philippines, South Africa and Egypt on *S. officinarum*.

The type specimen of this fungus is based on a collection by Butler from Burma in 1912 on *S. spontaneum*. The teleutospores (according to Butler) were immature and scanty and have not been observed elsewhere. In the Kopergaon specimen, however, we found copious formation of these but with some minor differences. A fuller description of the fungus is therefore, presented here.

Uredia hypophyllous, rarely epiphyllous. subepidermal, linear, single or gregarious. Spots 1-2 cm. \times 2-5 mm. with broad purple margin, which later turns dark coloured. Sori are exposed by rupture of epidermis. Uredospores are ovate or pear shaped, cadmium orange to xanthine orange in colour (Ridgeway), thick walled, echinulate, with two germ pores, measuring 21-40 (mostly 27-35) \times 20-25 μ , borne on hyaline, long stalks, from which they break off readily. Both at the margins and intermixed are paraphyses which are hyaline or yellowish in colour with a light greenish tinge, with capitate, rounded heads. The dimensions of the uredospores of the collections on various *Saccharum* species are as under:—

1	<i>Saccharum arundinaceum</i>	Coimbatore	33-42 \times 21-28 μ
2	" "	Poona	32-38 \times 22-28 μ
3	" <i>sara</i>	Lahore	26-38 \times 18-25 μ
4	" <i>navanga</i>	Mussoorie	28-40 \times 20-27 μ
5	" <i>fuscum</i>	Saharanpur	20-36 \times 20-27 μ
6	" <i>spontaneum</i>	New Delhi	25-33 \times 22-26 μ
7	" <i>officinarum</i>	Pusa	33-37 \times 20-23 μ
8	" "	Kopergaon	27-35 \times 20-25 μ

These show that there is no difference in spore size of the uredospores found on various *Saccharum* species.

Teleutospores arise in the same spots as the uredospores on the undersurface of leaf. The sori are smaller in size than those of uredospores and after the rupture of epidermis are somewhat darker in colour. Paraphyses are marginal. Teleutospores are bi-celled, clavate or club-shaped, rounded or somewhat flattened above, narrowed below, with a slight or no constriction at the septum. Upper cell is roundish but lower cell is sometimes bulging or narrowed below. These are borne on short stalks which are not deciduous. They are Sanford's brown in colour (Ridgeway).

Epispore is smooth, not uniformly thick, somewhat thickened at the apex and chestnut brown in colour (Ridgeway). Spores measure 30-57 (mostly 38-48) \times 17-22 μ without stalks, upper cell mostly 18-22 μ and the lower 20-26 \times 12-18 μ . Stalks 10-16 μ long. Fig. 1 shows a section of a teleutosorus with marginal paraphyses and Fig. 2 teleuto and uredospores.

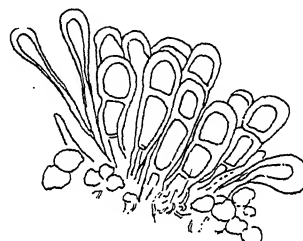


FIG. 1

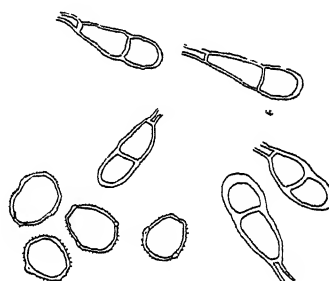


FIG. 2

FIG. 1. Teleutosorus with marginal paraphyses \times 250.FIG. 2. Teleutospores Uredospores of *Puccinia Kuehnii* (Krueg.) Butler \times 240.

The uredospores germinate readily in water in about 6 hours; 20-25° C. being the optimum temperature. The spores lose their viability after one month's storage at room temperature (20-25°C.).

Specimens of *Puccinia Kuehnii* (Krueg.) Butler on various *Saccharum* species, show the presence of its hyperparasite, *Darlucium filum* (Biv.) Cast., as has been reported by Padmanabhan and Rafay (1942) in the occurrence of this fungus on *Saccharum arundinaceum*.

Thanks are due to Dr. R. S. Vasudeva, for helpful criticism and to Dr. R. D. Rege for the material.

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March 28, 1950.

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NECROSIS OF THE MANGO FRUIT

NECROSIS in the mango can be attributed neither to any fungal or bacterial organism nor to the effect of the commonly known deleterious constituents of brick kiln fumes, e.g., sulphur dioxide, carbon monoxide, ethylene, etc. Das Gupta *et. al.* (^{1,2}). A survey of the affected orchards (Verma)⁵ suggested that brick kiln fumes however had some causal relationship to the necrosis. The disease could not be reproduced in any appreciable degree by burning coal (fuel used in brick kiln) in small improvised ovens in mango orchards during two successive seasons. About two dozen fruits at varying distances from the chimney got the disease, but this number out of a total of more than fifteen thousand is hardly significant. This is at variance with the findings of Sen⁴ who claims to have reproduced the disease by burning coal in ovens.

The disease has now been produced in healthy mango fruits of Dasehri and Safeda varieties by injecting sterile mango juice from healthy fruits in which brick kiln fumes have been passed for some time. Injections succeeded only in fruits of size $1\frac{1}{4}$ " to $3\frac{1}{2}$ " and as many as 50% developed necrosis. Injection of sterile mango juice extracted from healthy fruits served as control and had no effect on mango fruits.

An attempt was made to find out solvents other than mango juice for the constituents of the brick kiln fumes. The fumes were passed in different solvents, the solvents distilled and the residue, dissolved in sterile mango juice from healthy mango fruits, was injected in healthy fruits. Among the many solvents tried, ether and chloroform were found to absorb readily the disease inducing constituent of the fumes, ether being a better solvent than chloroform. 50% of the fruits injected with the ether-soluble portion of the fumes developed necrosis.

Three fractions have been separated from the ether-soluble constituents of the fumes. The first is sparingly soluble in cold petroleum ether, acetone, and ethyl alcohol and is soluble in ether and chloroform. It crystallizes in hexagonal form. It has a melting point of 110.5 ± 0.5 C. The second is sparingly soluble in acetone and ethyl alcohol and has a melting point of 61 °C. (uncorrected). The third fraction is a viscous mass easily soluble in acetone but sparingly soluble in ethyl alcohol. All the three fractions are soluble in mango juice. To test their reactivity, the three fractions were separately dissolved in sterile

healthy mango juice and injected into healthy Dasehri and Safeda fruits. Only the first fraction was found to be reactive. 50% of the fruits injected with the first fraction became necrotic.

In 1940 Das Gupta and Verma³ found that necrosis could be produced by injection of sterile juice from necrotic mangoes into healthy fruits. The microscopic appearance, chemical behaviour, and reactivity on mangoes of the ether-soluble constituents obtained from the juice of necrotic fruits seem to be similar to those of the ether-soluble constituents of brick kiln fumes.

Experiments have shown that if injections are made in regions of the fruit, other than the tip, necrosis is not produced; but the seed is killed as in advanced cases of natural necrosis.

How exactly the constituents of the brick kiln fumes cause necrosis is not known. There seem to be two possibilities. It may be absorbed directly by the fruits; or by regions other than the fruits and subsequently translocated to the fruits. The latter is the more likely.

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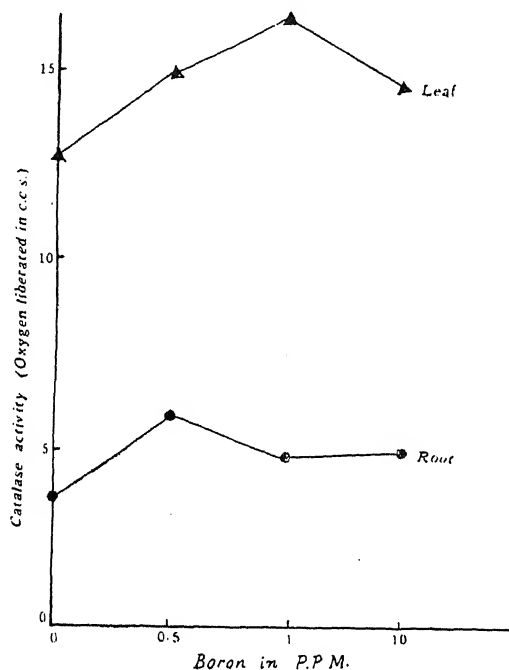
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THE EFFECT OF BORON ON THE CATALASE ACTIVITY OF RICE PLANT

ALEXANDER¹ found that boron deficiency increased the catalase activity in squash plants, whereas Bailey and Mc Hargue² reported that the addition of boron upto 1 p.p.m. increased it. As there was no general agreement, the present study on the effect of boron on catalase activity in rice plant was undertaken.

Rice seeds of C.H. 45 type supplied by the Central Rice Research Institute, Cuttack were sterilized by dipping for 10 minutes in 0.1% HgCl₂ solution. The washed seeds were germinated in sand and the seedlings were transplanted in glazed pots, containing sand. The composition of the nutrient solution was as follows: KH₂PO₄ — 1.25%, Ca (NO₃)₂ 4H₂O — 4.27%, MgSO₄ 7H₂O — 2.88%, (NH₄)₂SO₄ 0.38%, and 1 ml. of 1% Ferric tartrate solution

in 1 litre of water. $MnCl_2$ and $CuCl_2$ were added to the culture solution in concentrations of 1 p.p.m. Mn and .01 p.p.m. Cu.



Effect of boron on the catalase activity of roots and leaves of rice plant

The treatments, in triplicate, were 0.5, 1 and 10 p.p.m. of boron per pot added as boric acid in addition to a control with no added boron. Catalase activity of leaves and roots were determined separately at the end of 10 weeks^{3,4} and are given in the Fig. as c.c.s oxygen liberated from dilute (about 4 vols.) hydrogen peroxide at the end of 5 minutes by macerated extract corresponding to 0.1g of the plant tissue.

It may be seen that catalase activity in both the leaves and the roots increased when boron was added. Activity was less in roots than in leaves and far from being uniform.

Further work is in progress.

Grateful thanks are due to the Utkal University for the award of a Research Fellowship and to Dr. B. Samantarai for his kind encouragement and guidance.

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December 19, 1949.

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STUDIES ON THE OVARIES OF *POLYNEMUS TETRADACTYLUS* SHAW IN RELATION TO ITS SPAWNING.

P. Tetradactylus, known locally as "ravas", occurs seasonally in the Bombay waters, from January to April, and July to September. The mature and the spent forms are found in plenty, the immature and maturing ones being relatively few. Periodic plankton collections show that the larvæ and post-larvæ of this fish are found in the shore waters practically all the year round, suggesting that the fish breeds more than once a year.

The ovaries of immature fish measure 4.5" in length and 40 gms. in weight. The immature ova, with diameters varying from .10 mm. to .40 mm. are yolkless and transparent, with a distinct central nucleus in each.

The maturing ovaries are 5.5" long and weigh 60 gms. on an average. The ova are opaque, being packed with yolk granules and a few oilglobules. Yolk is deposited in the form of a thin granular layer along the periphery, and fills the enlarging ovum. Diameters of the maturing ova vary from .45 to .68 mm.

The mature fish, possesses extensively developed cream-coloured ovaries which vary from 6" to 10" in length and from 100 to 300 gms. in weight. The mature ova appear transparent, on account of the vacuolated condition of the yolk, and contain usually a single, large, shining oil-globule. Their diameters vary from .70 to .85 mm.

The spent fish which resembles the mature form in its body-length, has its ovaries distinctly flacid and reddish in appearance. They contain a large number of empty follicles from which "ripe" ova have been dislodged and spawned. A few ripe ova representing the remnant of the spawned crop are seen in the wrinkled ovarian sacs.

"Ripe" ova appear opaque rather than transparent, due to the breaking down of the vacuolated yolk into a paste-like semi-fluid diffused mass surrounded by a thin, clear, perivitelline space. The ova of the mature fish pass through the "ripening" stage prior to their spawning.

The fact that the mature fish contains only two types of ova, mature and immature, suggests that the spawning may not occur more than once a season. And since mature and spent fish are found simultaneously in two

1. Alexander, T. R., *Bot. Gaz.*, 1942, 103, 475-91

2. Bailey, L. F. and Mc Hargue, J. S., *Plant Physiol.*, 1944,

consecutive seasons, it follows that the fish spawns twice a year.

Dept. of Zoology, K. R. KARANDIKAR.
The Institute of Sci., V. C. PALEKAR.
Bombay,
March 29, 1950.

ADDENDUM TO LIST OF CHROMOSOME NUMBERS IN ECONOMIC PLANTS

THE somatic chromosome numbers have been determined in the following plants. These 2n numbers were obtained from sections of root tips and are based on maximum numbers counted from many intact cells in mitotic metaphase. As recorded in the previous communication¹ these counts show the prevalence of regularity and polyploidy in the chromosomes of Angiosperms. In all the species, the numbers recorded tally with counts recorded earlier for some of the related species. To bring out these features, the basic number of each genus is given in brackets along with the number newly recorded.

Species	2n number	Basic number of genus
<i>LEGUMINOSÆ</i>		
1 <i>Indigofera tinctoria</i> Linn.	.. 16	(8)
2 <i>Tephrosia purpurea</i> Pers.	.. 24	(8)
3 <i>Cassia obtusa</i> Roxb.	.. 28	(7)
4 <i>Cassia javanica</i> Linn.	.. 28	(7)
5 <i>Glycine javanica</i> Linn.	.. 20	(10)
6 <i>Prosopis glandulosa</i> Torr.	.. 26	(13)
<i>GRAMINEÆ</i>		
7 <i>Isilema laxum</i> Hack.	.. 36	(9 & 12)
8 <i>Enteropogon monostachyos</i> Schum	20	(10)
9 <i>Amphilophis foulkesii</i> C.E.C. Fischer	20	(10)
10 <i>Arundinella setosa</i> Trin.	.. 20	(10)
11 <i>Panicum pilopodium</i> Trin.	.. 54	(9)
12 <i>Setaria sphacelata</i> Stapf & Hubbard	36	(9)
13 <i>Digitaria smutsii</i> Stent?	.. 18	(9)
14 <i>Digitaria marginata</i> Link.	.. 54	(9)
15 <i>Phragmites karka</i> Trin.	.. 36	(12)
16 <i>Garnotia scoparia</i> Stapf.	.. 20	..

I wish to acknowledge my indebtedness to Sri. S. Sampath, Cytogeneticist, for his guidance and to the Government Lecturing and Systematic Botanist for the materials supplied for this investigation.

Cytogenetics Laboratory, K. RAMANATHAN.
Agricultural Res. Institute,
Coimbatore,
March 16, 1950.

1. Sampath, S., and Ramanathan, K., *Curr. Sci.*, 1949, 18, 11, 408-409.

A NEW FIELD HOST OF MICROBRACON HEBETOR, S.

Microbracon hebetor, S. (Hymenoptera, Braconidæ), the well-known ectophagous larval parasite, essentially, of the Rice and Flour moth, *Corcyra cephalonica* St., infesting a variety of stored food and other commodities in India, has recently been found here to extend its host preference to yet another important field pest, viz., *Sesamia inferens*, Walk. (Lepidoptera, Noctuidæ), whose caterpillar is a rather serious stem-boring insect of irrigated Ragi (*Eleusine coracana*), and other Graminaeous cereal crops like Jola (Jowar), Sugarcane and Wheat. The other field hosts of *M. hebetor* previously recorded in Mysore are (i) the Lab-lab (Avare) pod borer, *Adisura atkinsoni*, M., and (ii) the Jola earhead webbing caterpillar, *Stenachroia elongella*, H.—hosts that live and develop under cover.

Prior to oviposition, *Microbracon hebetor* paralyses the Ragi stem-borer larva (4th instar upwards); eggs are deposited all round the host-body; resulting parasite larvæ are pink conforming to the colour of the host, feed externally and pupate on and around the host-larva (which by now is dead); 11-27 cocoons are found per host arranged lengthwise lying end to end and overlapping in the narrow cavity of the host-tunnel in the stem. In April-May, the main breeding season of *Sesamia inferens* in irrigated Ragi, *M. hebetor* completes its life-cycle in 10-14 days \pm 9 hrs. at a temperature ranging from 68-97 °F. The emerging adults are active, feed on dilute honey and copulate; number of females and males almost equal, in one case, however, a large majority of female progeny was obtained (16:3); colour and size vary even in one and the same lot. Naked, exposed and partially exposed host-larvæ are also readily parasitised in the laboratory.

Field liberations of *Microbracon hebetor* against *Sesamia inferens* infesting irrigated Ragi, are being undertaken.

Entomological Laboratory, SYED USMAN.
Agric. Coll. & Res. Inst., B. KRISHNAMURTI
Bangalore,
May 1, 1950.

1. Appanna, M., *Curr. Sci.*, 1949, 18, 408. 2 Krishnamurti, B., and Appanna, M., *Agric. Coll. Res. Inst. Mys. Ent. Ser.*, Bull. No. 13.

ON THE OCCURENCE OF GLOSSOBALANUS PARVULUS (PUNNETT) ON THE OKHAMANDAL (KATHIAWAR) COAST

THREE species of Balanoglossids, viz., *Glossobalanus minutus*, *Glandiceps hacksi* and *Saccoglossus* (= *Dolichoglossus*) *bournei*, were recorded by Menon (1903) from the Madras coast. Rao (1934) reported the presence of *Chlamydothorax* (= *Ptychodera*) *ceylonica*, *Ptychodera minuta*, *Glandiceps hacksi* and a new species: *Chlamydothorax* (= *Ptychodera*) *krusadaiensis*, from the Krusadai Island (Gulf of Mannar). The writer is not aware of any later additions to this list of the Balanoglossid fauna of India, except for the record of an unidentified Giant Balanoglossid from the Galaxea Reef in Krusadai Island (Rao and Rao, 1949).

During studies of the fauna of the mud flats, east of Aramda (Okhamandal District-Kathiawar) half a dozen specimens of *Glossobalanus parvulus* (Punnett) were obtained from the exposed beach at 3.5 tide in September, 1947. The whole area was covered over with a deep layer of fine mud, and the specimens were collected while digging for burrowing worms. The mounts of 'castings' usually seen near the burrows of Balanoglossids, which are helpful in locating their abodes, were not noticeable here. The specimens ranged from 15 mm. to 28 mm. in length. More specimens were collected later from the exposed mud flats of Balapur Bay in Beyt Island (Gulf of Cutch).

Glossobalanus parvulus was described by (Punnett, 1906) from the Bahlos Atol in Maldiv Islands. Van der Horst (1939) gives this Atol as its only known habitat. The present one is the second record of this species, and the first record of a Balanoglossid from the Okhamandal area, and possibly from anywhere on the West Coast.

My sincere thanks are due to Dr. S. L. Hora, Director, Zoological Survey of India, for affording help in the identification of the specimens and Mr. S. P. Naidu for assistance during collection tours.

Zool. Surv. India Labs., T. V. R. PILLAY.
Calcutta,
March 3, 1950.

1. Menon, K. R., "Enteropneusta from Madras," *Quart. Journ. Mic. Sci.*, 1903, 47, 123-31. 2. Rao, C. R. N., "Enteropneusta from Krusadai Island," *Curr. Sci.*, 1934, 3, 70-71. 3. Rao, P. J. S., and Rao, S. R., "A note on the occurrence of a Giant Balanoglossid at Krusadai Island," *Journ. Bombay Nat. Hist. Soc.*, 1949, 48, 813. 4. Punnett, R. C., "The fauna and geography of Maldiv and Laccadive Archipelago, Cambridge," 1906, 2, 640-43. 5. Van der Horst, "Dr. H. G.

Bronn's Klassen und Ordnungen des Tier-Reichs," 1935, Bd. 4, Abt. 4, Buch. 2, Teil 939, 2, Lief 6, 698.

HYBRID MAIZE FOR THE GOKAK CANAL TRACT IN THE STATE OF BOMBAY

MAIZE, *Zea mays* L., is cultivated in two small zones in the State of Bombay, one of which is the Gokak Canal tract with an area of about 15,000 acres under the crop. Systematic breeding for evolving suitable hybrids for this tract was undertaken on the American lines at Arbhavi (District, Belgaum) in the year 1942-43. The work has resulted in two hybrids, viz., (1) $I_5 \times S_{23}$ and (2) $L_5 \times S_{23}$ which have yielded, on an average, 15 per cent. more grain than the local variety in 5 large scale trials. The inbred parents, I_5 and L_5 , come from the local variety and S_{23} from the African variety, Sahara. The hybrids are very similar to the local variety in grain characters and period of maturity which is about 95 to 100 days. The theoretically expected yield of the three way cross,

$$(I_5 \times L_5) \times S_{23}$$

is likely to be as good as of the single hybrids.
Office of the Dy. Director V. M. CHAVAN.
of Agric. (Crop Res.), S. G. KELKAR.
B.S., Poona 5, P. G. BIDARI.
February 27, 1950.

OCCURRENCE OF GREEN EAR STAGE IN SORGHUM

GREEN ear stage symptoms of two different types on jowar were observed, one at the College of Agriculture, Poona, and the other at Gothan in Olpad Taluka of Surat District during November, 1949. The individual spikelets in the panicle were transformed into



Fig. 1

narrow, long, leafy structures measuring 1-30×0.2-2 cm., each panicle consisting of 9-42 leafy structures. The appearance of these structures was characteristic of a typical infection by downy mildew on jowar (*Sorghum vulgare*). Unlike its counterpart in bajri (*Pennisetum typhoides*), these leafy structures appeared to grow from a central basal point on the floral stalk in the form of a whorl. There was complete suppression of the development of ovaries (Fig. 1, A-E). The leafy scales showed brown streaks which on examination revealed presence of oospores embedded in mesophyll tissues, arranged linearly in long rows and separated from each other by the vascular tissues. The conidial stage was evanescent.

The second type of symptoms referred to above results in transformation of the entire panicle into an appearance not at all dissimilar from the characteristic green ear found in bajri. The characteristic whorled appearance encountered in the first type of symptoms described above was absent. The green scales



Fig. 2

were much shorter and tubular, measuring 0.2-5 × 0.1 cm. Each proliferated spikelet appeared to retain its individuality in the panicle (Fig. 2).

Further work is in progress.

Plant Path. Section, M. K. PATEL.
College of Agriculture, M. N. KAMAT.
Poona, N. B. KULKARNI.
March 6, 1950. M. K. DESAI.

MYSORE CARDAMOM OIL

RAO, SUDBOROUGH AND WATSON¹ recorded only some physical constants of Mysore cardamom oil. The results of a more extended investigation of its ingredients are here reported.*

The cardamoms from Sakalasapur District in Mysore were steam distilled, and it was found that the sundried first quality yields a higher percentage of essential oil than the others (3.75 per cent. by weight of the whole fruit and 4 per cent. by weight of the seeds). The essential oil had the following physical constants: n_D^{25} , 1.4615; sp. gr. at 26° C. 0.9250; $(\alpha)_D^{25}$, +12.52. Such low values for optical rotation have not so far been recorded for Mysore oils. Rao, Sudborough and Watson¹ gave the value as +15.1° to +44°. Gildmeister and Hoffmann² have, however, recorded +12° to +15° for wild cardamom oil from Ceylon.

The aqueous portion of the steam distillate on extraction with chloroform gave .5 per cent. more of the essential oil and had the following physical constants: n_D^{25} , 1.4605; sp. gr. 0.920; $(\alpha)_D^{25}$, 0. The oil has a very penetrating odour and contains 80 per cent. cineol.

Its ester value is rather low, being only 38.8 (Rao Sudborough and Watson¹ give the ester value as 96.5 to 156.4). The acetylated product also had the low value 39.5 indicating that the percentage of free alcohol (probably terpineol) was low.

Fractions yielding high proportions of cineol³ (62.15%) and terphenyl acetate¹ (26.96%) have been obtained. None of the fractions gave tests for aldehydes and ketones.

The *lævo* rotation of the earlier fractions is probably due to the presence of a small quantity of *l*-sabinene.³

Our thanks are due to Dr. B. H. Iyer for help rendered in the preliminary stages.

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Bangalore 3,
April 3, 1950.

P. P. KRISHNAN.
P. C. GUHA.

* The work was undertaken at the instance of the Government of Mysore.

1. *J. Ind. Inst. Sci.*, 1925, **8**, Part X, 155-58. 2. *The Volatile Oils*, 1916, **2**, 28. 3. Gildmeister and Hoffmann, *The Volatile Oils*, 1913, **1**, 523. 4. —, *Ibid.*, 1913, **1**, 516. 5. Moudgill, *J. Soc. Chem. Ind.*, 1924, **43**, 137.

REVIEWS

Annual Review of Microbiology.—Vol. II.

By C. E. Clifton, S. Raffel and H. A. Barker. (Annual Reviews, Inc., Stanford, California), 1948. Pp. 522. Price \$ 6.00.

The second volume of this new *Annual Review* discusses eighteen topics of interest to microbiologists in general. A discussion on the phylogenical, morphological, taxonomic and ecological aspects of yeasts is given by Mark and Phaff. Lindegren, the well-known pioneer in the unexplored field of the genetics of fungi, has presented a critical review of the subject. A useful and stimulating review on the metabolism of malarial parasites by Moulder will be of interest to those interested in the study of pathogenic plasmodia. The rapidly expanding field of antibiotics has been brought up to date by Bailey and Cavallito who have emphasised the mode of action and the development of resistance in relation to antibiotics. Of particular interest is the review of Hotchkiss on the mode of action of chemotherapeutic agents. The controversial topic of biological fixation of nitrogen has again been reviewed by Vitanen, one of the principal workers and contestants in the field. Other subjects discussed in the review include:—Microbiology of soil by Smith, Microbiology of drinking water and sewage by Smit, Chemical disinfectants by Wyss, Bacterial plant pathogens by Burkholder, Neurotropic viruses by Schultz, Spirochetes by Davis, Nature of antibodies by Campbell, Pathogenic streptococci by Ramelkamp and Dingle, Inheritance of immunity by Gowen, and Growth factors of micro-organisms by Koser. Each of the reviews presented in the volume is comprehensively documented by references to original papers. We are confident that the volume will receive the same warm reception which its sister volumes have received in the past.

Advances in Enzymology, Vol. IX. Edited by F. F. Nord. (Interscience Publishers Inc., New York), 1949. Pp. x+730. Price \$ 9.00.

This volume contains discussions of twelve topics covering a variety of biochemical and physiological subjects. It is refreshing to note that the proportion of contributions from laboratories other than American is increasing, five out of the twelve emanating from England, Sweden and Germany; this is indicative not only of the return of the normal conditions for

scientific work in Europe, but also of the persuasive powers of Editor Nord who has a genius for organising such "Advances".

Physico-chemical aspects of enzyme reactions are covered by two reviews on (1) Some aspects of reversible step reactions and (2) Kinetics of biological reactions with special reference to Enzyme processes. The widely scattered literature on the subject of the Photochemistry of enzymes, proteins and enzymes has been reviewed by McLaren; particular importance will be attached to this helpful review by those interested in the rationalised production of lethals and mutations in plants and animals by ultra-violet irradiation.

Walker, one of the earliest pioneers in elucidating the mechanism of acid formation by fungi, has presented an able and clear review of the confusing literature pertaining to this subject. Glick's short contribution on the Principles of enzymic histo- and cytochemistry will be welcomed by the more enterprising cytologists interested in the detection, location and estimation of enzymes in tissues and tissue fluids. Other contributions include Industrial Biosyntheses.—Part I: Fats, by Hesse, Enzyme activity in frozen vegetable tissue, both subjects of industrial interest.

Mann's masterly review on the metabolism of semen is of great practical interest in view of the expanding practice of artificial insemination as a means of animal breeding. The mechanism of the fertilisation of Metazoa by Runnström, the nature of viruses by Lauffer and others, Chemistry and enzymology of nucleic acids by Schlenk, Nitrogen metabolism of higher plants by Street, are the other topics presented in this volume.

The "Advances" will continue to be eagerly welcomed by all investigators interested in the varied aspects of biochemical research.

The Theory of Inbreeding. By R. A. Fisher. (Oliver & Boyd, Edinburgh and London), 1949. Pp. 120. Price 10sh. 6d.

Many books have been written on the advantages of inbreeding and the methods followed in certain experimental farms but few have provided a satisfactory quantitative approach to the various problems of inbreeding. In what way one method of inbreeding is better than the other? In how many generations can

we expect a desired progress by following a particular method of inbreeding? What happens when a certain programme becomes irregular due to a desired offspring being not available? What is the best course to follow in such cases? On a solution of these problems depends the choice of a successful breeding programme leading to a desired progress in a minimum number of generations.

The importance of inbreeding is not sufficiently realised. The process of improvement is undoubtedly slow. But 'the forty-nine years which have elapsed since the discovery of Mendel's work would have sufficed to supply the present generation of animal breeders material of utmost value had the adoption of inbreeding programmes not been delayed by prejudice and inertia, reinforced perhaps by superstitious fear.' Recently, by following the cyclical operations of choosing a suitable foundation stock, inbreeding to produce nearly homozygous lines and crossing chosen lines, considerable improvement has been achieved in maize yield. Such an improvement was responsible for a substantial increase in the national income of the United States of America. This resounding success makes it certain that the theoretical and practical aspects of inbreeding should be studied in greater detail. R. A. Fisher has given a lead to a comprehensive programme of research in the theory of inbreeding by discussing in his book various designs of inbreeding programmes, and the relative speed with which homozygosity is achieved in each case.

For experimental purposes a line can be inbred while maintaining segregation in a desired number of factors. Such inbred lines provide controlled comparisons of genetic differences ascribable to single factors or an interaction of two or more. They also preserve living genetic material which may be readily available for comparison with genes discovered later. Otherwise a good deal of preliminary experimental work would be necessary. A third advantage is that inbred lines supply continuous data for linkage studies. By proper planning, all possible linkages of a number of known factors can be studied by maintaining replicated inbred lines, in each of which a relatively fewer number of factors are kept segregating. The number of families needed to maintain a segregating inbred line depends on the expected number of eligible matings available in the number bred. The mathematics leading to the evaluation of this expected number is given in Chapter II of

this book. This obviously depends on the number of factors kept segregating and the number of young ones born to a family.

The third Chapter deals with the progress towards homozygosity. The mathematics involved in this Chapter is, indeed, complicated but is presented in such a style that is easily understood by non-mathematicians. The idea is simple. Starting from a certain number of initial matings available it is easy to determine the expected number of various types of mating available in the next generation. This is simply given by the product of a row vector f_0 giving the initial frequencies and a matrix A called the generation matrix. By applying the same rule the frequencies f_n in the n -th generation are given by the product $f_0 A^n$. To determine A^n the matrix A is first reduced to the canonical form

$$A = C \begin{pmatrix} \lambda_1 & & \\ & \ddots & \\ & & \lambda_p \end{pmatrix} C'$$

where $\lambda_1, \dots, \lambda_p$ are the latent roots of the matrix A and C is an orthogonal matrix so that $CC' = I$ in which case

$$A^n = C \begin{pmatrix} \lambda_1^n & & \\ & \ddots & \\ & & \lambda_p^n \end{pmatrix} C'$$

If the roots correspond to the matrix obtained by omitting the frequency of matings of the type $aa \times aa$ (doubly homozygous), then the speed with which homozygosity is reached depends on the convergence to zero of the n -th power of the highest root. To determine the relative speeds of various inbreeding programmes only the dominant latent roots of the corresponding generation matrices need be compared. A simple calculation on this basis reveals that 7 to 8 generations of selfing is equivalent to 23 or 24 generations of sib-mating.

The same principle is used to measure the irregularity or retardation due to intercalating a mating of a different type in a certain inbreeding programme when a desired offspring is not available.

In Chapter IV are considered various systems of inbreeding and their generation matrices. The results of mating a particular phenotype D and not D and the condition of a locus on the same chromosome as a segregating dominant have been discussed in relation to sib and parent offspring matings. The most important sections of this Chapter are those concerning polysomic segregation. In this case further complications arise due to double reduction but the algebra is same

as that used earlier. In the case of tetraploids and hexaploids it is seen that approach to homozygosity is slower than that of diploids for all types of inbreeding.

In an appendix are considered the most efficient designs of inbreeding for species bearing one offspring at birth.

The first large-scale systematic study on hybrid vigour was made by Darwin and published in 1876. Although much experimental work was carried out since then there is no well established theoretical explanation as to why when two dissimilar inbred varieties are crossed the offspring shows hybrid vigour. Dominance of certain genes offers a good explanation but recent experiments have shown that this does not offer the complete explanation. There is a good deal of research work to be done in this direction. Hybrid vigour has an important part to play in animal and plant improvement. Inbreeding is an essential step in effecting such an improvement. R. A. Fisher has given in this book a comprehensive treatment of the consequences of various systems of inbreeding. This is, indeed, a great boon to future research workers engaged in problems of animal and plant improvement.

C. RADHAKRISHNA RAO.

High Polymeric Chemistry. By W. S. Penn. (Chapman & Hall Ltd., London), 1949. Pp. 473, Illustrated. Price 36sh. Net.

The chemistry of high polymers is becoming an important branch of study in view of its close relationship to industrial processes on which the newer plastics are based. A high polymer is a macro-molecular structure synthesised from simple organic substances, the monomers, by poly-condensation or polymerisation reactions. Knowledge of the chemistry of these reactions is yet scanty but is advancing rapidly and continually. The book fulfils the need for a readable account of the increasing flow of new information on the subject.

Information in the first three chapters of the volume covers the nature of macro-molecules and fractionation of polymers; theories of polymerisation reactions and methods in use for following up and completing these reactions; study of the shape and structure of high polymeric substances by the Electron microscope and X-ray analysis. In Chapter 9, the properties of high polymers are explained on the basis of their molecular structure and the more important features which decide their chemical and physical properties indicated.

The chemistry of polymerisation of styrene, methyl styrene, dichlorostyrene, ethylene, isobutylene and acenaphthylene are dealt with in the fourth chapter. The structure, preparation, and commercial aspects of polyvinyl chloride, polyvinyl acetate, polyvinylidene chloride and co-polymers, polyvinyl acetals, polyvinyl pyrrolidones, polytetrafluoroethylene, polymethyl methacrylate and poly allyl compounds are described under "vinyl" polymers. This is followed by an account of the most important reactions of unsaturated hydrocarbons, the specific influences in the polymerisation of Dienes and the structures of the resulting synthetic rubbers.

Fibre forming materials like nylon, polyurethane and terylene as well as thiokol rubbers and alkyds are dealt with under "Condensation" Resins. Natural high polymeric substances like cellulose and protein are considered in relation to their use as plastics and synthetic fibres in the next two chapters. Mention is made of allyl starches. The reactions leading to the formation of phenolic and amino plastics and theories regarding their structures are then presented. The organo-silicon esters, the silicones, also receive attention.

The methods of preparation of monomers are described in Chapter 15. Due emphasis is not, however, placed on the commercial methods followed.

The author rightly concludes that there is unending possibility for research in high polymers, and indicates possible trends of future lines of work on the subject, such as improving known polymers; developing new polymers; new techniques of production, e.g., low temperature polymerisation, suspension polymerisation, etc.; new applications of polymers and new methods of synthesis of monomers.

The book is an attempt to present the existing basic literature on high polymer chemistry. It is specifically directed to the "Chemical" rather than the "Plastics" aspect of the subject. Mathematical considerations of the theories of polymerisation have been avoided in the work and the processes explained in simple terms. The author touches the fundamental background of the chemical factors in the preparation, properties and use of synthetic and natural high polymers. References given at the end of each chapter for more detailed reading add to the value of the volume.

N. SRINIVASAN.

The Fundamentals of Electromagnetism. By E. G. Cullwick. (Camb. Uni. Press), 1949. 2nd Ed. Pp. 327. Price 18sh. net.

Every teacher is familiar with the confusion in the minds of students regarding the different systems of units in Electricity and Magnetism—the electrostatic, the electromagnetic and the practical units—which make the calculations none too easy. Much of this confusion is due to the fact that the orthodox text-books in the subject follow the convention of starting with a definition of magnetic poles and electric charges as real entities and with the assumption that the fields associated with the magnetic poles and the electric charges are unconnected with each other. The book under review boldly gives up this conventional method and bases itself on the fundamental facts of modern physics.

Starting with the electron—the fundamental and indivisible unit of electric charge of modern Physics—as a physical reality, the author develops the ideas of electrostatic field, electric potentials and electric currents of different types along with the related quantities. The magnetic field and the laws of electro-magnetic induction are dealt with as associated properties of a group of electrons in motion. In the beginning itself the inter-relationship between the different systems of units is stressed and the Metre-Kilogram-Second (MKS) system is introduced.

The author has eminently succeeded in presenting the fundamental facts of electromagnetism, electromagnetic induction and electromagnetic waves in a manner, which is simple and lucid and yet preserves the essential unity and coherence of the subject as a whole. The student who understands the basis of the MKS system of units will find it very easy to work out problems in the subject. The book will no doubt be found to be highly useful to the Physicist and Engineer alike.

C. S. V.

Electric Power System Control. By H. P. Young. Third Edition (Revised and enlarged). (Chapman & Hall), 1950. Pp. 456. Price 28sh.

This is No. XI of a very useful series of Monographs on Electrical Engineering published by Messrs. Chapman & Hall. First published in 1942, the book meets a very important need of both practising Engineers in the field of power system operation and students specialising in power engineering.

This is indicated by the fact that the book has already run into a third edition.

In this edition, the author has added two chapters on automatic protective systems—an important link in the complete set up for an electric power control. An efficient and economic operation, in the largely interconnected power systems of to-day, requires the use of automatic protective systems for machines as well as transmission and distribution lines. This subject has been very lucidly and logically dealt with by the author in the last two chapters. Other matters dealt with in a coherent way include: parallel operation of generators; automatic regulation both for voltage and power factor control; automatic devices for accurate synchronizing of large turboalternators; large capacity and high speed circuit breakers, including air-blast circuit breakers, and improved system design, by use of reactance, for the control of power; automatic and remote control of voltage and power factor in interconnected systems; and use of supervisory control of systems for centralized control in large interconnected systems.

The book is an authentic survey of all contemporary literature on the various aspects of power system control. The useful bibliography at the end of the book has been brought up-to-date in each chapter. The usefulness of the book in the practical field and for students cannot be overemphasized.

C. S. GHOSH.

Elements of Internal Combustion Turbine Theory. By H. T. Adams. (Published by Cambridge University Press), 1949. Pp. 178. Illustrated by diagrams. Price 16/-.

The author of the book is Senior Lecturer in Mechanical Engineering at Canterbury University College, New Zealand. He became known as author of "The Aircraft Gas Turbine," a compilation of lectures, which were given by him at Lutterworth. The two volumes were distributed amongst official technical bodies, e.g., N.G.T.E. Pyestock in England. Their content has been enlarged and modernized and forms now the book being reviewed here.

After a brief introduction into the fundamentals of the gas turbine, and a very short historical review on the development, the author sets out the thermodynamic relationships governing the theoretical cycle. Due consideration is given to the effects of compressibility on a gas flowing through a nozzle or an orifice. The next three chapters deal with compressors, the centrifugal and the

compressor in all their aspects, such as design, performance estimation and testing line. After dealing in the details with the turbine and with aerodynamic properties of turbine blades methods of stressing the component parts are given. The important subject of stresses is another chapter, mentioning centrifugal forces, impeller vibrations, and stresses of rotors. A further and very interesting chapter describes the overall performance for full and part load with methods of corrections for data found by standard atmospheric conditions. A further chapter gives an introduction to heat exchangers and their design, the technique of inter-cooling. The combustion, the combustion chamber, etc., are mentioned briefly. For convenience an index and a bibliography are included, a considerable improvement. Other-
wise the book is very useful as a short introducing information which is not found in most of the technical books in the field till now.

H. A. HAVEMANN.

The Physiology of Plants. By A. S. B. Currier and C. R. Stocking. Botanical Company, Waltham, Mass. (A. Macmillan & Co., Calcutta), 1949. Pp. xi+240. Price \$ 6.00. Botanists should be thankful to the authors of this monograph for bringing together (1949) all the relevant literature on the subject in one concise volume. The English on this subject is that published in 1929. The present volume is a mere compilation but deals with a coherent, synthetic and critical

apters of the book deal with the osmosis, osmotic relations and movement and loss of water in plants. The structure of water has been dealt with, which is perhaps the first book on plant physiology. This chapter on solutions emphasises the peculiar properties of water solutions in explaining the many aspects of the behaviour of water in plants. Chapters IV, V and VII deal with water potential, on the intracellular movement of water, discusses water as a part of the cell and the binding of cell colloids acting upon it. The five cell water relations (Ch. VIII)

emphasises the active part played by protoplasm in the control of water and its distribution in the plant body. Uptake, movement, retention and loss of water comprise the last two chapters and can be profitably read by the botanist and the agronomist alike. Each chapter finishes with a lucid summary which is useful to the student in giving him a proper perspective. The text is aptly illustrated and wherever necessary the authors have referred to the analytical methods employed.

The book is primarily intended as a reference work by the authors who hope "that its reading will not be so tedious as to preclude its use in the classroom". But too thorough a knowledge of physical chemistry has been assumed of the student and it will be rather tough reading for the under-graduate classes. More than 800 papers have been reviewed and the monograph with its comprehensive bibliography will make an excellent reference book for the post-graduate research workers in plant physiology.

N. N. N.

Annual Review of Biochemical and Allied Research in India, Vol. 19. (Society of Biological Chemists, India), 1950. Pp. 76. Price Rs. 3 or 6 sh.

This seventy-six page Annual Review of Biochemical and Allied Research in India for 1948 which has made its belated appearance in 1950, catalogues the researches without any pretensions to appraise critically the work, which, judged by international standards, will remain unspectacular, inconsequential and third rate.

Palaeobotany in India

The latest number (VII) of Palaeobotany in India, a Bulletin of Current palaeobotanical research, issued by the Birbal Sahni Institute of Palaeobotany, contains abstracts of more than 80 items of research, dealing with fossil plant material,—macro and micro—found in rocks of different ages in India ranging from the Pre-Cambrian to the Pleistocene. The Bulletin is an impressive record of the nature and variety of palaeobotanical studies being conducted in this country and reveals the importance of such studies from the botanical, stratigraphical and geological points of view. It is, however, sad to see that this first number of the Bulletin to be issued by the newly founded Institute of Palaeobotany has had to open with the Obituary Notice of the eminent Palaeobotanist, Prof. Birbal Sahni, to whose wholehearted initiative and endeavour the Institute owes its very existence.

Sound Absorption and C. Kostic Company, Inc., New York. \$ 3.00.

The study of sound is a theoretically and an integral part of acoustics. The study of acoustics is a new and better review consideration and exhaustive prove of great interest and to those who are interested in materials. The basis of the wave theory of normal acoustics is analogous to the theory. The review is completely devoted to making the theory satisfy the need of the practical problem and construction of view and, where necessary, representations have been made understanding a series of conditions.

The book contains a subject-matter for the style of presentation outlines the theoretical homogeneous medium equation for the medium, the parallel loaded with a rigid wall are directed to the medium in the medium. The interesting features of the geometrical representations developed with the thermodynamic porous media the behaviour of the theory, which forces and the and its consequences. III deals with homogeneous, the phenomenon of exhibited by the. Mention is also cases of complete coupling of the results are given. Chapter IV outlines the primary material

Sound Absorbing Materials. By C. Zwikker and C. Koston. (Elsevier Publishing Company, Inc., New York), 1949. Pp. 174. Price \$3.00.

The study of sound absorbing materials, both theoretically and experimentally, forms an integral part of the acoustical design of auditoria and studios as well as of the manufacture of new and better materials. The book under review considers these problems in a thorough and exhaustive way and, therefore, would prove of great value to acoustical engineers and to those who design and make construction materials. The treatment adopted is on the basis of the well-established concept of the normal acoustic impedance of the material and is analogous to the electrical transmission theory. The relevant mathematics has been completely developed throughout the book, thus making the treatment rigorous enough to satisfy the needs of a theoretical worker. Also, the practical problems that arise during design and construction have been constantly kept in view and, wherever possible, graphical representations have been given to facilitate the understanding and use of the analytical equations.

The book contains eight chapters. The subject-matter for each chapter is well chosen and the style of presentation is good. Chapter I outlines the theory of sound absorption by homogeneous media. After deriving the general equation for the impedance of an infinite medium, the particular cases of a finite medium loaded with a complex impedance and by a rigid wall are discussed. These are then extended to the more general case of an impervious medium with internal friction. The interesting feature of this chapter is the geometrical representation of the analytical equations developed. Chapter II deals in detail with the thermal and viscous effects of the porous media thus taking cognizance of the behaviour of practical materials. Kirchhoff's theory, which takes into account the viscous forces and thermal conductivity, is developed and its consequences are brought out. Chapter III deals with the absorption of sound by homogeneous, porous and elastic layers. The phenomenon of acoustical double refraction exhibited by these materials is explained. Mention is also made of the two interesting cases of complete coupling and complete decoupling of the doubly refracted waves and the results are geometrically represented. Chapter IV outlines the measurement of elementary material constants while Chapter V de-

scribes the measurement of normal acoustic impedance. Chapter VI discusses the experimental results conducted both with artificial samples and with commercial materials of different types, and interprets the results, wherever possible, in the light of the theoretical analysis given in the earlier chapters. Chapter VII considers the theoretical as well as the practical aspects of absorption of sound by single resonators. The more general cases of perforated panels and panels with slits backed by absorbing material are discussed and design charts are provided for these cases with illustrations. The last chapter considers the problem of oblique incidence and points out the complications involved in the theoretical analysis and in measuring techniques.

Professor Zwikker, the senior author of this book, and his colleagues have made valuable contributions to this branch of acoustics. There can be no doubt that this book fulfils its aim admirably and it is hoped that it will stimulate further thought and work along the directions indicated.

N. B. B.
D. L. S.

Hand Book of Aerial Mapping and Photogrammetry. By Lyle G. Trorey. (Cambridge University Press), 1950. Pp. xvi + 178. Price 25 sh. net.

The author, with characteristic humour, mentions in his preface that his presentation of photogrammetry is not very unlike the Chinese practice of putting the roof on the house before they build the rest, claiming with some reason, that by so doing they are able to carry on the work without any interference from the weather!

The theory of perspective geometry is treated in some detail in the first Chapter just to provide the minimum amount of scaffolding to support the roof. The rest of the theory is presented mainly in the form of exercises or worked examples.

Besides perspective geometry, the opening Chapter deals with anharmonic ratios, and the Scheimpflug condition which one meets with in the operation of epidiascopes, rectifiers and the like. The second Chapter opens with a classification of air-survey photography into (1) ground survey photographs which are usually taken with the optical axis accurately horizontal, and the plate therefore vertical, (2) high or horizon obliques (in which the optical axis is tilted suitably to include the visible horizon), and (3) low or non-horizon

obliques secured by further depressing the optical axis till the horizon no longer appears in the picture. The rest of the Chapter deals with the methods adopted for the measurement of angles from obliques. Perspective grid and four point methods, measurement of height from a single oblique, verticals: fundamental conditions of cover, parallax and stereoscopes, parallax and elevation calculations, radial line triangulations, rectification means, principles of stereoscopic plotting instruments and the multiplex projector are some of the other topics discussed in the following chapters.

As appendices, we have accounts of the standard mapping procedure in vogue among the Royal Canadian Engineers, and of multiplex and stereoplanigraph equipment.

Photogrammetric methods have their limitations too, and these are presented on page 90. To overcome the loss of definition resulting from motion of the aircraft, a moving film Camera is suggested as a remedy. In spite of its restricted photogrammetric applications, the Sonne Camera is said to produce sharp photography at a very large scale from fast moving aircraft. In this camera the sensitive film is made to move at a controllable speed upon a fixed focal plane slit. For perfect synchronisation, the speed of the film is to the speed of the aircraft as the ratio of the focal length to the altitude, when there will be no motion of the image relative to the film during the exposure.

Dr. Treorey's book is most valuable for the man who wants to make maps from air photographs. A fastidious observer might remark that formulæ quoted are not always proved. But those interested in proofs can obtain them elsewhere. The practical application of the formulæ is rendered very clear by the large number of worked examples. As the author himself puts it succinctly, although the metamorphosis from the plain sheet of paper to the finished three colour sheet may seem complex and mysterious, the entire process may be broken up into a number of unit operations each of which is simple and easy to understand. Than this there could be no better description of the book. Photogrammetry and stereoscopy can be difficult to comprehend. But this book gives a delightfully clear treatment of the entire problem by analysing it into

a number of small comprehensive processes, each of which is explained fully.

P. SRINIVASA ROW.

Nomenclator Zoologicus, Vol. V, 1936-45.

Edited by S. A. Neave. (Published by the Zoological Society of London, Regent's Park, London, N. W. 8), 1950. Pp. 308. Price 3½ guineas.

Nomenclator Zoologicus is an indispensable book of reference for all taxonomists in Zoology. It deals with all the generic names used in zoological literature in any part of the world. The first four volumes of this work were published in 1939 and 1940, and the present volume is the fifth in the series dealing with over 18,000 generic names published between the years 1936 and 1945 both inclusive. The Zoological Society of London has acquired the copyright of the work and, with the help of a special fund known as the Neave-Lloyd *Nomenclator Zoologicus* Fund, hopes to continue to issue one volume of this series every ten years covering the new generic names used in zoological literature, provided of course that the publication will receive the encouragement and financial support of zoologists.

Considering the difficulties met with in the collection of the scattered zoological literature published during World War II, the work has been carefully planned and executed, and is free from printers' errors. The main work is followed at the end by the Addenda and Corrigenda to the first four volumes already published, the shortness of which is a measure of editorial care and alertness.

The significance of a thick or thin dagger before some class or sub-class names, as for instance against Mammalia (*Ictidailurus* on p. 122), is not explained. The omission of the group, class or phylum in the case of old names of genera where the cross reference is on a different page places the reader at a slight disadvantage.

The volume is well printed and bound, but the price appears to be very high and beyond the means of all except Institutions and Institutional Zoologists.

Nevertheless, systematic zoologists all over the world owe a deep debt of gratitude to the Zoological Society of London for the promise held to bring out a regular series of publications of this type every ten years.

H. S. R.

SCIENCE NOTES AND NEWS

Fossil Fish and Crabs in the Fuller's earth bed at Kapurdi, Jodhpur, Rajasthan.

Mr. S. K. Barooah, Director, Department of Geology and Mining, Government of Madhya Pradesh, Nagpur, writes:—

The occurrence of fossil mollusca and microforaminifera in the Fuller's earth bed at Kapurdi ($25^{\circ}54'30''$: $71^{\circ}22'30''$) had been reported in a previous communication.¹ These fossils had enabled the beds to be determined as belonging to the Laki series.

Since then some fish remains have been collected and one seemingly well preserved in parts was sent to Dr. E. I. White of the British Museum (Natural History), London, for determination along with a few crab remains.

Professor White writes to say that the fish is a clupeoid but not further determinable and might be any age in the Tertiary. None of the specimens collected so far measures more than three inches in length.

Of the crab, it is said that they are not well enough preserved for close determination unless perhaps by empirical matching with known material.

On reference to Dr. Gordon, she considered that these crabs from the Kapurdi Fuller's earth bed, if they are fresh-water forms, probably belong to the Potamonidæ (transitional forms between tribes Catometopa and Cyclo-metopa), but that if they are brackish-water or marine forms they belong to some family of the Catometopa, perhaps Ocypodidæ or Grapsidæ. The crabs occur both singly and in clusters of two or more individuals.

My grateful thanks are due to Dr. E. I. White and to Dr. Gordon of the British Museum for determination of the above fossils.

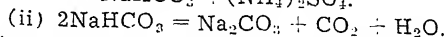
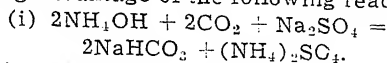
1. *Curr. Sci.*, 15, 11, 317.

Utilisation of the deposits of sodium sulphate at Didwana

Miss Lily B. Desai and Mr. S. M. Mehta of the Royal Institute of Science, Bombay, write:

In June 1944, M. S. Patel¹ suggested to the Technical Mission from the U.K. appointed by the Government of India to advise them on the question of the production of artificial fertilisers (ammonium sulphate) in India, that if Didwana sodium sulphate^{2,3,4} could be made available in sufficient quantity at a reasonable price for at least 25 years it could be utilised

for the production of ammonium sulphate and soda-ash at the proposed fertiliser plant by taking advantage of the following reaction:—



Since there are no data in the literature on the study of the above reaction under Indian conditions, we have performed a series of experiments with sodium sulphate (kindly procured for us by Dr. Patel) and ammonium carbonate under varying conditions of temperature, molal ratio and dilution. It is found that the reaction proceeds smoothly in solution with conversion of as much as 50% of sodium sulphate into sodium bicarbonate, the excess of the latter coming down as fine amorphous precipitate. The mother liquor left over consists primarily of ammonium sulphate and sodium bicarbonate along with the unconverted sodium sulphate and ammonium carbonate. By using the mother liquor as solvent in subsequent reactions as much as 65% of sodium sulphate is converted into sodium bicarbonate in a single reaction. The reaction gives without any recourse to refrigeration a reasonable yield of almost pure sodium bicarbonate which could easily be converted into soda-ash; ammonium sulphate can be recovered without much difficulty from the mother liquor at a certain stage in the cycle of reactions.

Details of the work will be published in due course.

To Dr. M. S. Patel the authors are grateful for his kind suggestion. They also desire to thank Dr. B. N. Desai of the India Meteorological Department for his interest in the work.

1. Patel, M. S., Private Communication. 2. Dunn-cliff, H. B., *Curr. Sci.*, 1943, 12, 7-12. 3. Spencer, E., *Ibid.*, 176-80. 4. Dunncliff, H. B., *Ibid.*, 295-98.

International Union of Crystallography

By kind invitation of the Swedish National Committee for Crystallography, the Second General Assembly and International Congress of the Union will be held in Stockholm from 27th June to 3rd July 1951. These dates have been chosen in consultation with the Swedish National Committee and with the National Committees of all the Adhering Bodies. Copies of the First Circular (March 1950) can be

had from the General Secretary of the Union, R. C. Evans, Crystallographic Laboratory, Cambridge, England; or from the Secretary to the Government of India, Department of Scientific Research, North Block, Central Secretariat, New Delhi.

Electrochemical Society Inc.—India Section

The inaugural meeting of the India Section of the Electro-Chemical Society Inc. was held on the 23rd and 24th March at the Indian Institute of Science, Bangalore. Dr. B. K. Ram Prasad, the President-elect, delivered the inaugural address on "Some Aspects of the Development of Electro-chemical industries in India". Dr. K. L. Ramaswamy (Sindhri) and Mr. J. Balachandra (Bangalore) were elected Vice-Presidents and Dr. T. L. Ramachar (Bangalore) as Secretary-Treasurer.

Zoological Society of India

The Annual General Meeting of the Calcutta Branch of the Zoological Society of India was held at 34, Chittaranjan Avenue, Calcutta, on April 28, 1950, under the Chairmanship of Dr. S. L. Hora, Director, Zoological Survey of India. The following office-bearers were elected for the year 1950 :—*Chairman* : Dr. J. J. Bhaduri, D.Sc. F.N.I.; *Secretary* : Mr. B. Biswas, M.Sc.

Sir Ian Heilbron

The Lord President of the Council has appointed Professor Sir Ian Heilbron, D. S. O., F.R.S., Emeritus Professor of London University, to be Chairman of the Advisory Council for Scientific and Industrial Research in place of

Sir Geoffrey Heyworth who has resigned owing to pressure of other public duties.

Research Degree Award

On the recommendation of the Board of Examiners consisting of : Sir Ian Heilbron, F.R.S., Prof. H. Raistrick, F.R.S., and Sir J. L. Simonsen, F.R.S., the thesis entitled "Studies on the Chemical Components of Certain Indian Plant Products," by Sri. S. Sankara Subramanian, M.Sc., has been declared qualified for the D.Sc. Degree of the Andhra University.

University of Madras

Applications are invited for the following appointments in the University of Madras:—

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The last date for receipt of applications (8 copies) is 30th June 1950.

ACHARYA PRAFULLA CHANDRA MEMORIAL FUND

THE Indian Chemical Society have opened a Memorial Fund in the name of its Founder-President, the late Acharya Prafulla Chandra Ray, to perpetuate the memory of his services to India. A target of Rs. 2,00,000 has been provisionally fixed, from the interest of which the Society proposes (i) to arrange for an annual Memorial Lecture by a distinguished scientist on suitable remuneration and the award of a Souvenir Medal, (ii) to grant scholarships to meritorious post-graduate students of chemistry all over India and (iii)

to award the annual P. C. Ray Memorial Prize to the best Indian Research worker in chemistry. This appeal which is supported by distinguished scientists like Sir. J. C. Ghosh, and statesmen like Drs. S. P. Mukherjee and B. C. Roy, will, it is hoped, receive the generous response of all scientists, industrial magnates and the general public.

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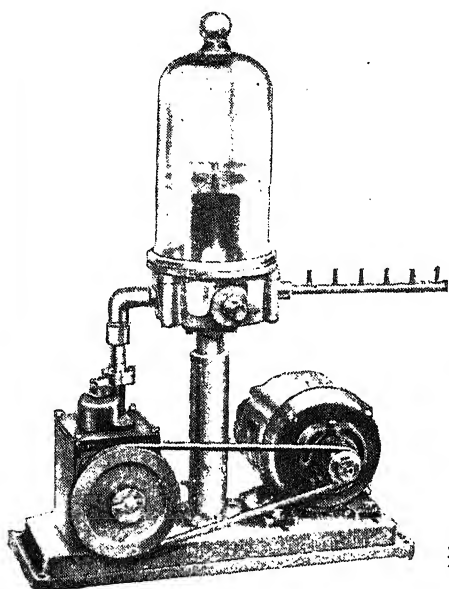
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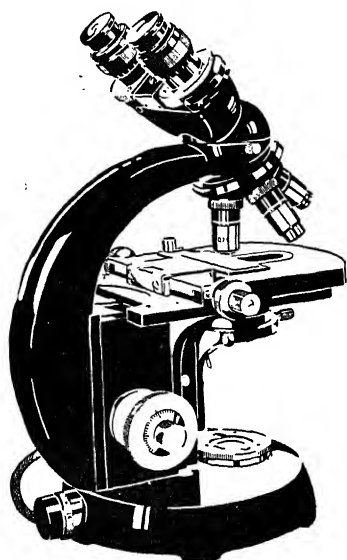
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JUNE 1950

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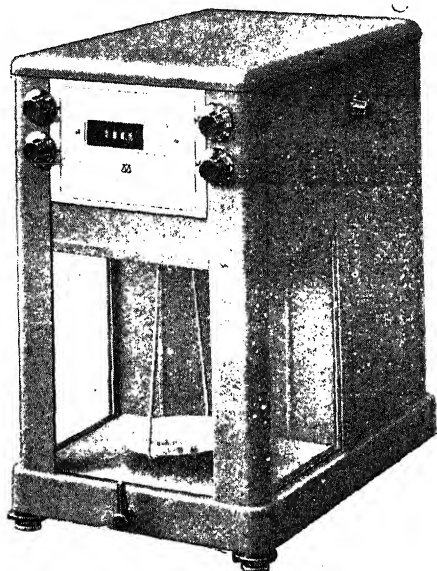
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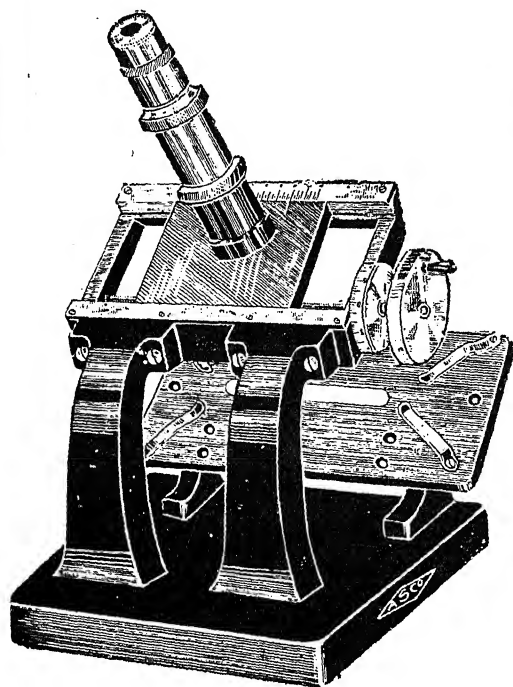
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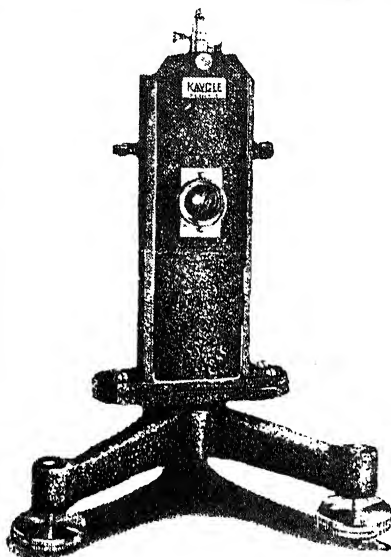
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A PLEA FOR THE ESTABLISHMENT OF SCIENTIFIC SUPPLIES STORES IN INDIA

THE difficult and unhappy position in which scientific workers in India have continued to find themselves with regard to the supply of essential research equipment, glassware and chemicals is an irritating circumstance which we have helplessly and patiently tolerated all these years. The blame for not having built up a scientific instrument industry in the country should be laid at the door of the scientific worker who has not taken the initiative to organise precision instrument shops and fine chemical factories, where he could have forged his research "tools" and manufactured his essential chemicals. He has lost two golden opportunities, the periods of the two world wars, during which many of his compeers in other countries similarly situated, stole a march over him and established industries which not only met their needs but left a surplus for export.

A few feeble and inconsequential attempts have, however, been made; they did not secure the support they deserved. The wartime prosperity which was only transient vanished with the return of peace.

There are, in general, two channels through which these supplies are obtained by Government departments, the research institutes and the Universities. They are: (1) reputed commercial concerns or (2) some agency of Government such as the Indian Stores Department,—Director-General of Industries and Supply, Trade Commissioners, Scientific Liaison Officers and Supply Missions attached to the Embassies, etc. With both these channels, the administrative machinery is complex, involved and sluggish, resulting in considerable delays.

In addition, the cost of the material is considerably enhanced by the time it reaches the laboratory *via* a number of commercial intermediaries. In a survey conducted at one of the larger research institutions in South India, it was found that the cost of chemicals and glassware imported directly from U.K. or U.S.A. after landing at that laboratory, was approximately 2½ to 5 times less than that of those articles purchased from Indian commercial concerns. It is estimated that in a centre like Bangalore alone, roughly 6-7 lakhs are

being annually spent in excess of the legitimate costs of those articles due to lack of central organisations for these supplies. The following plan is therefore suggested for the consideration of the authorities concerned, with the primary aim of achieving two objectives: (1) Economy of funds and (2) Speed of procurement.

It is suggested that in the first instance, four Regional Scientific Supplies Stores be organised, one each at Calcutta, Delhi, Bombay and Bangalore, to be either directly in charge of the Department of Scientific Research of the Government of India, or to be managed by an approved firm of suppliers under the control of the Central Government. Almost all research institutions, University laboratories, etc., within the orbit of each of these centres can be served easily and effectively from these four cities. Each of these centres would collect the requirements of the next two years of various research institutions in their zones, secure currency releases for articles to be imported, call for quotations either from local dealers or from manufacturers directly, arrange for inspection, finalise the transactions for purchases, and stock the materials in their Stores. The laboratory or department concerned would then merely arrange to draw from this store its requirements as and when needed.

This procedure would save much unnecessary correspondence, expense and delay in the

procurement of these materials and would effect a substantial saving in the costs of materials as also in packing, freight, insurance costs, etc. In some cases, where orders are placed directly with the manufacturers, it may even be possible to secure substantial discounts for bulk purchases. Moreover, the laboratories of research institutions would be saved a lot of administrative work and could then devote greater attention to the prosecution of research with increased speed and added enthusiasm. It is the experience of progressive research laboratories in our country and abroad that maximum efficiency can only be achieved if, in addition to other facilities, the Scientific Supplies Stores are located in the very backyard of the laboratory. An example in point is the organisation of Scientific Stores by the Defence Department for its research laboratories. Therefore, we urge the learned bodies of our country such as the Scientific Workers' Association, the Indian Science Congress, the National Institute of Sciences, etc., to give their expert opinions on the solution of this important problem, and jointly appeal to the Department of Scientific Research and to our leaders of Science to set up the necessary organisation to establish these scientific supplies stores in India at an early date.

K. K. I.
M. S.

LADY TATA MEMORIAL TRUST

Scholarships and Grants for the year 1950-51

THE Trustees of the Lady Tata Memorial Trust announce on the death anniversary of Lady Meherbai Dorabji Tata, 18th June 1950, the awards of Scholarships and Grants for the year 1950-51.

The International Awards of varying amounts (totalling £3,000) for research in diseases of the blood with special reference to Leucaemias are made to Doctors Edith Paterson (England), Pascou Atanasiu (France), J. Bichel (Denmark), E. Kelemen (Hungary), Charles Oberling (France), Gunther Schallock (Germany), Astrid Fagraeus and Bo Thorell (jointly) (Sweden), Niels M. G. Harboe (Denmark),

M. Henri P. L. Febvre (France) and George Discombe (England).

Indian Scholarships of Rs. 250 per month each for one year for scientific investigations having a bearing on the alleviation of human suffering from disease are awarded to Messrs. P. R. Srinivasan (Coonoor), D. Siva Sankar (Madras), Gangagobinda Bhattacharya (Calcutta), and Doctors Dharmendra Pal Singh (Agra), Samavedam Srinivasa Sriramacharyulu (Andhra) and Dr. (Miss) Sunita Popatlal Bharani (Bombay). A special award of Rs. 100 a month for one year from July 1950 to Mr. Jamshed R. Tata (Bangalore) has also been made.

PROGRESS OF RESEARCH IN NATIONAL LABORATORIES

AT the National Physical Laboratory in New Delhi, a precision Beta-Ray Spectrograph is now being built for studying the energy distribution of beta-radiations from radioactive substances. Many of the component parts, such as the power supply unit and linear amplifiers for simple and coincident counting, have already been assembled. These highly sensitive instruments are expected to record readings as small as a hundredth part of a second. The results of this study may find important application in the field of medicine where many radioactive substances are used for diagnostic and curative purposes.

The construction of a quartz clock which has been taken up will ultimately be controlled by an atomic clock providing a standard for the measurement of time which would be unaffected by known factors. For studies in optics, a number of optically plane and concave surfaces of substantial area, the largest about two feet in diameter, have been prepared. The reflecting surfaces are provided by extremely thin films of aluminium and other metals deposited by evaporation in vacuum.

Other investigations in the field of fundamental physics relate to the determination of nuclear magnetic moments by resonance of micro-waves and dispersion and absorption of ultrasonics in liquids.

In the sphere of applied physics, two important lines of investigation bearing on the preparation of carbon brushes and other carbon products, and separation of some rare earths from one another and study of their luminence when used as activators in suitable phosphor are under way. These investigations are expected to find application in the preparation of luminous paints and gas mantles.

The National Chemical Laboratory at Poona is conducting experiments on the utilization of tobacco seed and safflower oils in the manufacture of paints and varnishes.

In the Inorganic Division, new and quick methods of estimating rare metals and minerals are being developed. Work has also

begun on the beneficiation of ores of precious metals.

Processes for the manufacture of citric acid, calcium gluconate and vitamin C have been developed in the Biochemistry Division. The economic implications and technical aspects of these processes are now being investigated with a view to making the processes available to industry at an early date.

In the Fuel Research Institute at Dhanbad, investigations on the subject of coal washing are in progress, and a cyclone type of washer has been designed. Another line of investigation is the possibility of separating fractions of coals with reduced ash and improved coking characteristics from high ash coals by controlled breakage and subsequent screening. This is expected to result in separation of vitrain from durain in coal.

The Central Glass and Ceramics Research Institute in Calcutta has evolved a good thermal insulating material from waste glass styled "Foam Glass"; this is light and porous, and its use in house construction should tend to reduce the effects of extreme heat and bitter cold. It is expected that the investigation will shortly reach a stage when commercial production can be begun.

The National Metallurgical Laboratory at Jamshedpur is evolving a process by which low-grade manganese ores can be converted into manganese sulphate for the production of electrolytic manganese dioxide. Work on the control of grain size in austenite steels is being continued. This should lead to better use being made of imported metals, such as nickel and chromium.

The Building Research Unit at Roorkee has been concentrating on low-cost houses and conducting a series of investigations on sun-dried clay roofing tiles, soil cement floors and wall plasters from mud. A survey of clays used in the making of bricks in various parts of the country with a view to determining the compressive strength of the bricks is in progress.

CENTRAL GLASS AND CERAMIC RESEARCH INSTITUTE

THE fourth in the chain of National Laboratories the Central Glass and Ceramic Research Institute is being rapidly fitted up and will soon be formally opened in Calcutta.

The Institute which is now working with a nucleus staff under a Joint Director, is already serving as the Central Bureau of technical in-

formation for the ceramic and glass industry in the country. A large number of requests for advice have been attended to and when the Institute starts functioning with full complement, it is hoped that it will serve as the main focus of research and development in ceramic and glass industry in India.

IT'S FOR YOU TO CHOOSE*

EDWARD M. WEYER, JR.

WE think of 50 years as a long time. On Earth's great timepiece, it is a second. But there is a sundial that says: "It's later than you think."

Once, long before man, it was size that counted. A little animal only a foot long, which has been popularly called Leaping Lena, founded a dynasty of giant creatures that could reach leaves three stories above the ground.

If we could have watched the growth of the dinosaurs through 140 million years, we might have believed that size and strength alone were most desirable for success. But Nature had something else in store—something that was to wipe the giants from the earth, almost as if they had never lived.

It became common for a small animal to win over a large one. In a limited sense, the meek inherited the earth. Actually, a better nervous system was evolving. Evolution was laying the foundations for the creature that talks, laughs, plans, and calls himself master of the world—the creature that invents, chooses, and learns from books—the creature whose mysterious desires can bring him close to God and whose pride can cast him lower than the beast.

This creature shivered his way through half a million years before he discovered how to make fire. It took him almost as long again to make a good machine to put it out.

Evolution teaches that three things are necessary to produce change—Variation, Selection, Transmission. If all of Leaping Lena's children had been alike, there could have been no change. But anyone who has raised dogs knows that there are variations in every litter. In the wild, some young are better able to survive the hazards of life—are stronger, swifter, more gifted in the arts of concealment. So a process of natural selection takes place. The ones better fitted to meet life's conditions are more apt to survive to maturity. And some that reach maturity are more likely to secure a mate, produce their kind, and transmit their effective traits to the next generation.

There is a comparison between this kind of evolution—organic evolution—and cultural evolution.

The difference is that cultural evolution refers to all the tools that man uses and all his laws and social institutions. These are not

passed on by heredity but chiefly through books and spoken tradition.

In cultural evolution, *invention* plays the part of *variation*. *Choice* takes the place of *natural selection*. And a lot of things that might be bunched together under 'education' take the place of *transmission* and keep alive the tools and customs we judge desirable. They form the design for to-morrow. The design is the heritage we leave our children.

So we have Invention, Choice, Design.

Speech was the first great achievement that put man on the road to cultural evolution. It permitted the transmission of powers from parent to child without heredity. Written language greatly quickened the process, because it took the burden off memory.

Man now has a multitude of machines to help him build new machines. He even has electronic 'brains' to solve mathematical problems.

In the last 50 years, science has given us the motion picture, the airplane, radio, poison gas, television, radar, jet propulsion, atomic power, antibiotics and the tools of bacterial warfare.

In the next 50 years, science will give us things that will prolong life and things that will shorten it, things that will appeal to your highest nature and to your lowest. But no one can tell what the world will be like, because it's for you to choose.

We are beginning to see that our skill in choosing falls far behind our inventive talent. We find ourselves driving a 100-mile-an-hour car with a 10-mile-an-hour steering wheel.

Whether we shall spiral upward or downward will depend upon this process called Choice. As long as there is freedom of judgment, it is up to you to choose. Scientists will help us beyond their role of inventing and testing new paths. They will advise. But the choice must be yours.

Focussed on this vital act of choice are two powerful forces. One is the creed that *Might Makes Right*. The other is the belief that the *Strong Shall Help the Weak*. One feeds on hate, the other on love. One is destructive, the other creative. One breeds strife, the other peace. They are at opposite poles. You can't very well believe in both at the same time.

Science will give us miracles. We shall need also the miracle that raises us above our creature origin. Science can plant two seeds where there was one. So can the thief grow more vicious, the larger the loot.

* By courtesy of the *Natural History Magazine*—An Editorial written on its 50th Anniversary.

It tires man to fix his calendar to the seasons and his timepiece to the stirring of life in a tiny cell. The wheels can be spread on the laboratory table, but who can yet put them together? We plant the seed in the field and then must wait obedient to natural law. Before God, can we show surprise if, after sowing atoms and confessing no regret, we are to reap them?

We are all one with the earth and shall return to it. The slum-child pressing its cheek to the fresh grass. A man going home to the mountain.

Invention-Choice-Design. For good or ill, these are the handmaidens of our destiny. When Choice becomes Moral Responsibility, Invention becomes Inspiration, and the Design is full of Hope.

TECHNICAL ASSISTANCE: A TWO-WAY TRAFFIC*

NEVER before has the earth been a whole, as it is today, nor has it appeared so to as many people. Slowly, everywhere men and women, often unwillingly it is true, are coming to understand that peoples cannot be free of one another.

This understanding is the basis of what has come to be called the "technical assistance programme" of the United Nations and such specialized agencies as the Food and Agricultural Organization and the United Nations Educational, Scientific and Cultural Organization. Sooner or later, depending upon economic pressure from peoples, the world will function as one.

Reluctantly, even the prosperous are beginning to understand that "backward peoples" must be educated, the undeveloped areas developed, if not for their own sake, then for the sake of those who wish to maintain their present standards of living. Countries such as the United States, which produce more than their people can buy, at least at present prices, must be able to sell to outside peoples, and those peoples must be educated to the point of wanting the new goods, and developed to the degree of being able to buy them. Crudely put, this is the vague idea behind much of the planning today.

Once begun, we may trust to the peoples, however backward they may be considered, to shape the process as it goes on, and in that shaping we shall all be modified. It will be impossible to have the Chinese peasant educated without his also educating us. The Chinese have educated more people than have ever educated them. India has already shown the unconquerable independence of her mind and spirit.

It's for you to choose.

Two wars leave us in pain, and the world is sick. Black, white, yellow, red—each in his Maker's image: each exalted, each tempted. At home we deny our brother, while we add new strength to the old weapon. We were born in the day but have defiled our place in the sun. Those born in the night reach for our hand but do not find it; and a cloud rolls in, low over the earth.

Our brief time here has been a wedding of Hate and Power. In this union, dare we pray for the daughters of Love-Moral Responsibility Inspiration, Hope?

Having brought ourselves to the edge of Eternity, dare we not pray for them?

In the contact that is now inevitable between the peoples of Occident and Orient, the greatest change will come in the Occident. It will not be so visible, at first, as the change in the Orient. A refrigerator is a monstrously visible thing, but the change in a man's attitude toward life is far more important and powerful.

Nearly everyone recognizes that in all countries there are spots of modern civilization, individuals of profound culture. There is no lack of admiration for these, no unwillingness to grant their superiority. In the average American, for example, there is today a humility almost touching toward such figures as Gandhi and Nehru.

We must not think that the people sometimes spoken of as 'backward' consider themselves so for one moment. Having achieved the height of sophistication, which is the ultimate in simplicity, it is not likely that the ancient peoples of the East will allow their ordered lives to become confused by machinery not adapted to their needs.

While I do not believe that there are any backward peoples, I know that there are great undeveloped areas in our world. The emphasis needs to be put upon the development of these areas, physically, in communications, food and public health; mentally, in literacy and cultural interchange, and spiritually, in mutual understanding and willingness to sacrifice. I know, too, that there is the means for this development, and it is simple in action. This is the purpose and meaning of "technical assistance".

* From an article by Pearl S. Buck, by courtesy of the *Courier*.

FORRESTER'S FORMULA FOR THE DETERMINATION OF CALORIFIC VALUE OF INDIAN COALS

V. ARAVAMUTHAN AND S. S. GHOSH

(Dept. of Metallurgy, Indian Institute of Science, Bangalore)

RESULTS of proximate analysis like ultimate ones have been employed for calculating the calorific value of coals, and from time to time various formulæ have been proposed for the purpose. Forrester¹ proposed a formula specially for coals of Raniganj and Jharia fields as follows:—

$$C_g = 80.8 C + KV,$$

where C_g = calories per gram

C = fixed carbon per cent

V = volatile matter per cent

and K is a factor which varies from 86.5 to 103.25 for various seams.

compared with those calculated from Forrester's formula applying as far as possible correct 'K' values for respective seams proposed by Forrester as given below.

As shown in Table I, wide differences have been noticed between the two values for each sample. It is, however, interesting to note that, in general, with increasing ash content the difference between the observed and calculated values goes on increasing. Although there is fair justification in accepting the figure 80.8 as the calories contributed by each 1% of fixed carbon present in one gram of

Seams	..	5, 6, 7	10	11	12	13	14 & 14 A	15	16	17 & 18	Raniganj
K =	..	103.25	95.53	98.35	97.2	96	97.75	94.5	94	90.5	86.5

The calorific values of nine representative samples of Indian coals obtained from Bengal and Bihar fields through official sources were determined by Bomb method and the values

coal,* the reason for this wide difference may be attributed to the empirically derived values of 'K', and as such, they are to be accepted with reserve.

TABLE I

Sample No.	Source	Proximate Analysis (oven-dry coal)			Calorific value (oven-dry coal) calories per gram		Difference
		Volatile matter %	Fixed carbon %	Ash %	Experimental by Bomb method	Calculated by Forrester's Formula	
1	Raniganj Series, Dishergarh Seam, Saltore Colliery	38.16	47.95	13.89	7218	7175	43
2	Raniganj Series, Dishergarh Seam, Parbelia Colliery	36.93	48.89	14.18	6955	7145	-190
3	Jharia Field, New Jeenagora Colliery, Seam No. 6 in Geological order	22.70	56.92	20.38	6667	6943	-296
4	Jharia Field, New Jeenagora Colliery, Seam Nos. 5 and 6 in Geological order	21.75	52.87	25.38	6211	6518	-307
5	Jharia Field, Central Jeenagora Colliery, Seam Nos. 6 and 7 in Geological order	22.73	55.69	21.58	6542	6847	-305
6	Jharia Field, North Borari Colliery, Seam No. 10 (3rd section)	22.66	52.42	24.92	6185	6394	-109
7	Jharia Field, North Borari Colliery, Seam Nos. 5 & 6 in Geological order	17.15	43.43	39.42	4833	5280	-457
†8	Jharia Field, Khas Kusunda Colliery, No. 8 Seam, Bottom section	18.48	64.74	16.78	6998	7139	-141
†9	Jharia Field, Central Keshalpur Colliery, Nos. 8 and 9 Seams	17.51	61.40	21.09	6571	6769	-198

* Calorific value of carbon being taken as 8080 calorie per gram.

† 'K' values for seams 8 and 9 are not given by Forrester. We have taken average figure between those of 5, 6, 7 seams and 10 seam.

Obviously, the values of 'K' were derived by Forrester on the assumption that for a seam the volatile matter has the same composition everywhere and hence the same calorific value. This is not correct since the amounts of vitrain, durain and fusain materials vary from place to place in the same seam² and even at one spot when traversed from floor to roof.³ Another important factor which has generally been overlooked is the error introduced by inert ingredients such as (a) occluded gases in coal, (b) moisture from mineral matters and (c) product of decomposition of pyrites, which escape during volatile matter determination. The errors of volatile matter naturally appear in the ash. In other words, the ash 'as found' gives a lower figure than the true mineral matter in the coal. The necessary correction according to Parr⁴ will be

Mineral matter = Ash \times 1.08 + .55 sulphur or volatile matter 'as found' should be decreased by 8% of the 'as found ash' plus .55 times total sulphur in coal.

Although Parr's correction is not mentioned with any special reference to Indian coals, Forrester's formula was applied after introducing Parr's correction to volatile matter. From Table II it is clear that even by making the aforesaid correction appreciable difference exists, though reduced in magnitude, between the calculated and determined values. In case of four samples, however, the values are in close agreement.

Hence it is suggested that a correction similar to that of Parr's on volatile matter must be applied before any calculation of calorific value is attempted by the use of any formula such as Forrester's. Parr's correction may not

TABLE II

Sample No.	Oven dry coal		Correction to be applied to Vol. matter (according to Parr)	Corrected Vol. Matter %	Calorific value by Forrester's formula on Corrected Vol. Matter	Difference between Experimental and Calculated Figures
	Ash %	Total sulphur %				
1	13.89	0.33	-1.30	36.86	7063	155
2	14.18	0.29	-1.30	35.63	6952	3
3	20.38	0.46	-1.89	20.81	6748	-81
4	25.38	0.41	-2.26	19.49	6234	-73
5	21.58	0.31	-1.90	20.83	6650	-108
6	24.92	0.46	-2.25	20.41	6185	nil
7	39.42	0.28	-3.31	13.85	4938	-105
8	16.78	0.34	-1.53	16.95	6981	17
9	21.09	0.36	-1.89	15.62	6574	-3

be applicable as such to Indian coals owing to the high percentage of ash they contain and the difference in the mineral matter composition from British and American coals. Reliable data on the nature of mineral matter and also the composition of volatile matter for various seams at different places must be available to make use of any empirical formula based on proximate analysis. Investigations in obtaining such useful data are in progress.

The assistance rendered by the office of the Coal Commissioner for India in the collection of samples with every available details is thankfully acknowledged.

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FULBRIGHT TRAVEL GRANTS

AS already announced, the United States Educational Foundation has been established in India, New Delhi, to finance certain educational exchange programmes under the Fulbright Agreement. The Government of the United States of America will make available necessary funds in Indian currency to finance various schemes. The amount set aside will be utilised partly for providing free transportation to selected Indian nationals who wish to attend United States educational institutions of higher

learning in the United States, Hawaii, Alaska (including the Aleutian Islands), Puerto Rico and the Virgin Islands.

Indian nationals wishing to qualify for travel grants under the Fulbright Agreement should apply direct to the Executive Secretary, the United States Educational Foundation, American Embassy, Queensway, New Delhi. The applications should be made in the prescribed form available from that office.

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ABSORPTION SPECTRA OF THALLIUM
HALIDES

THE absorption spectra of TlI, TlCl and TlBr have been investigated in the region $\lambda 6500$ – $\lambda 2200$. An examination of the new absorption photographs obtained for TlI in the present work, has led to an important modification in the analysis of the main system³¹⁻¹ Σ^+ reported by the author and K. R. Rao,¹ earlier in emission. The origin had to be located at $\nu 26339.6$ instead of at $\nu 25780.0$ and the vibrational quantum numbers v' and v'' had to be increased by 11 and 13 units respectively. The revised vibrational constants are

$$\nu_e = 26361.7 \quad \omega_e' = 93.4 \quad \omega_e'' = 123.5 \\ x_e' \omega_e' = 0.10 \quad x_e' \omega_e'' = 0.09$$

No systems of TlI attributable to the transitions $^3O^+ - ^1\Sigma^+$ and $^4\Pi - ^1\Sigma^+$ have been obtained in absorption.

The two systems of TlCl lying between $\lambda 4200$ – $\lambda 3800$ and one for TlBr in the region around $\lambda 3950$ analysed by the author^{2,3} from

emission photographs have not occurred in absorption.

Andhra University, P. TIRUVENGANNA RAO.
Waltair,

April 20, 1950.

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MICRO-FOSSILS FROM THE BAGH
BEDS OF BARWAHA NEAR
INDORE

OUR knowledge of the marine Cretaceous Bagh fauna of the Narbada valley is confined only to the mega-fossils: Echinoids were described by Duncan¹; Ammonites by Verdenburg² and Bose³; Bryzoa, Echinoids, Rhynchonellids, Lamellibranchs and Ammonites by Chiplonkar.⁴ These authors considered the fauna to be Cenomanian in age. Fourtau⁵ who

re-examined the Echinoids came to the conclusion that they were Albian in age. Micro-palaeontological examination of the collection from the khalar river cutting east of Yelam (Lat. $22^{\circ} 10'$: Long. $76^{\circ} 1'$) near Barwaha has shown the presence of foraminifera and calcareous algæ, which are both important in fixing the age of the beds.

The sequence of the rocks is as follows:—

(5) Traps with Intertrappeans containing *Physa prinsipii*.

(4) Coralline limestone with a sandstone parting in between.

(3) Upper Gondwanas (exposed around Ghatia and Katkut).

(2) Bijawar limestones (exposed around Barwaha and east of Agarwara).

(1) Archæans (exposed east of Barwaha).

The material that has yielded the microfossils belongs to the upper band of the calcareous limestone. In hand specimen the limestone is arenaceous with a calcareous matrix and remains of Bryozoa and Corals predominate.

Thin sections of the coralline limestone show the following micro-fossils:—

Algæ	{	<i>Neomeris</i> sp. (Fig. 1).
		<i>Archæolithothamnium</i> sp. (Fig. 2).
Foraminifera	{	<i>Globorotalia</i> sp.
		<i>Globigerina</i> sp.

Neomeris sp.—Fragments of the Dasycladaceæ *Neomeris* are found showing sporangia with two secondary branches characteristic of the genus. The thickness of the shell is 0.25 mm.; sporigial diameter 0.136 mm. with stalk

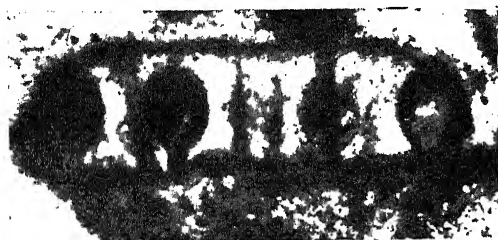


FIG. 1. *Neomeris* sp. $\times 65$. Loc.—Barwaha near Indore 0.2 mm.; the diameter of the secondary branches is .05 mm. Measurement indicates that the species is different from those described from Rajahmundry⁶ and Trichinopoly.⁷ The geological record of *Neomeris* does not go below the Upper Cretaceous.

Archæolithothamnium.—The family Corallinace is represented by the genus *Archæolithothamnium*, which shows the conceptacles,

ovoid, isolated and arranged in zones, and the perithallial and hypothallial cells.

Among the foraminifera *Globorotalia* and *Globigerina* are present. The genus *Globorotalia* first appears in the Cenomanian.⁸

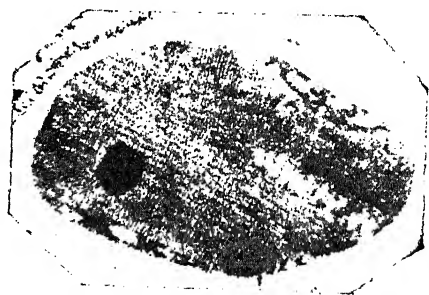


FIG. 2. *Archæolithothamnium* sp. $\times 45$. Loc.—Barwaha near Indore

The presence of *Neomeris* and *Globorotalia* suggests that the Bagh limestones collected cannot be older than the Cenomanian. A more detailed report is under preparation.

The author is indebted to Prof. S. R. N. Rao for his guidance.

SURESH NARAYAN SINGH.

Dept. of Geology,
University of Lucknow,
Lucknow,
April 13, 1950.

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ON A SMALL COLLECTION OF PLANT FOSSILS FROM SAURASHTRA

A SMALL collection of plant fossils was made by one of us (K. P. V.) from Tartar and Dhuli, two villages about 8 and 25 miles respectively from Than Railway Station in Saurashtra. So far as we are aware no plant fossils have been reported from these localities although from Sonagarh, a place about 8 miles away, the following plant impressions have been recorded by F. Fedden¹: *Pecopteris* sp., *Tæniopteris* sp., *Podozamites lanceolatus*, and *Echinostrobus expansus*. Our collection shows the following impressions.

Tartar.—The plant fossils in this locality were all found *in situ* in black ferruginous

shales, forming a part of a fossiliferous bed more than 6 feet in thickness. The impressions are not very well preserved but in many places a little of the carbonised material is still preserved. Attempts to macerate these to recover cuticles or spores have failed so far. The impressions have been identified as far as the imperfect preservation permits, as follows:

Sphenopteris sp.—There are at least six different types of leaves that can be referred to this form genus, but so far only fragmentary specimens have been found and it has not been possible to institute any definite comparisons.

Cladophlebis whitbyensis.

Cladophlebis sp.—Here too nearly eight different kinds of fronds are recognised. It is likely that they represent different forms of the same species, but even here, their fragmentary nature and badly preserved venation prevent further comparisons.

Brachyphyllum sp.—Possibly *Br. mamillare* (Brong). Several well branched specimens of this are present.

Araucarites cutchensis (Fst.).—Cone scales referred to this species, are intermediate in size between those of *A. cutchensis* and *A. macropteris*. But as their general form is more like that of *A. cutchensis* and in the absence of any other distinguishing characters, we prefer to keep them under this species itself. The frequent association in some of our rock specimens, of *A. cutchensis* and the above referred species of *Brachyphyllum*, to the complete exclusion of any other plant remains, rather temptingly suggests that the two might possibly be the reproductive and vegetative parts respectively of the same conifer.

A small conifer shoot with spirally arranged leaves closely resembling *Elatocladus plana* Fst. is also present.

Dhuli:—

Impressions of only *Cladophlebis indica* O & M sp. have been found in whitish clay, dug out of a well.

A fuller paper on this collection which is being worked out, will be published elsewhere. This investigation was supported by a grant from the Scientific Research Committee of the U.P. Government.

Dept. of Botany & Geology,
Lucknow University,
April 1950.

A. R. RAO.
K. P. VIMAL.

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B₁₂ CONTENT OF MOLDY BRAN AND BROOD LAC EXTRACTS

IN the course of our studies on the microbiological assay of the B complex vitamins of aqueous extracts of moldy bran and brood lac, it was found that they contained some growth factors other than those shown to be present when the "all-vitamin" medium was employed for assaying.¹⁻³ Addition of the moldy bran extract in concentrations corresponding to 20 mg. of nitrogen of the extract per 100 ml. of the "all-vitamin" medium gave a 20-25% increase in acidity.

The presence of B₁₂ and its functionally related compounds have been tested for their presence in the extracts with the aid of the lactic culture, *L. lactis* Dorner, kindly supplied to us by Drs. Kocher, and K. K. Iya.* The response was strikingly positive and preliminary estimates reveal the presence of 1.6 my B₁₂ activity per c.c. of moldy bran extract and 0.17 my per mg. nitrogen of lac extract. The data are computed from a standard curve which was obtained by using a solution of crystalline B₁₂. Compared with liver extract, however, the moldy bran extract contains only 0.148 of the B₁₂ potency of the latter. The differential test for thymidine and B₁₂ has not yet been made. The details of the investigations, now under progress, will be reported elsewhere. Our grateful thanks are due to Merck & Co., New York, for the gift of B₁₂ (Cobione) ampoules.

Fermentation Tech- D. S. VENKATESH.
nology, Indian Inst. M. R. RAGHAVENDRA RAO.
of Science, Bangalore, M. SREENIVASAYA.
June 10, 1950.

*Obtained from Lederle Labs., Pearl River, New York.

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INFLUENCE OF ADSORPTION OF FeCY₆^{'''} AND Cd IONS, AND THAT OF HYDROLYSIS ON THE COMPOSITION OF CADMIUM FERRICYANIDE

THE composition of cadmium ferricyanide had been studied by conductometric and thermometric titrations.¹ The variations in the titre values suggested the following study to assess the part played by hydrolysis and adsorption in the precipitation of cadmium ferricyanide.

Fairly stable sol of strength 2.5 gm./litre was prepared by mixing cadmium sulphate and potassium ferricyanide solutions in the molar proportions 1 : 5/4. The sol was dialysed for

5 days, and mixed with cadmium sulphate and potassium ferricyanide solutions respectively, at several concentrations, and FeCy_6''' and Cd adsorbed per gm. of the precipitate was determined.

Dilution effect on the sol in respect of the released FeCy_6''' was also studied by coagulating it with A.R. ammonium sulphate, on determining the amount of FeCy_6''' in the supernatant solution.

The accompanying curves show that the release of FeCy_6''' per gm. of the complex is much greater in the undialysed sol than in the

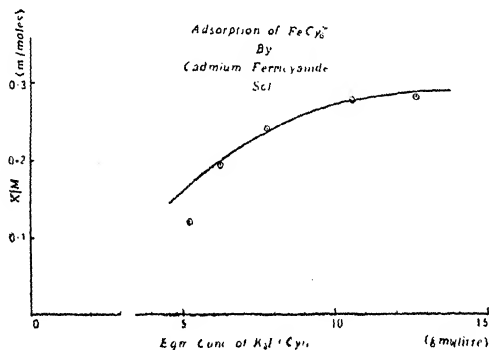


FIG. 1

dialysed ones. Gradual increase of FeCy_6''' released on dilution of the sol, suggests that the sol suffers hydrolysis to some extent.

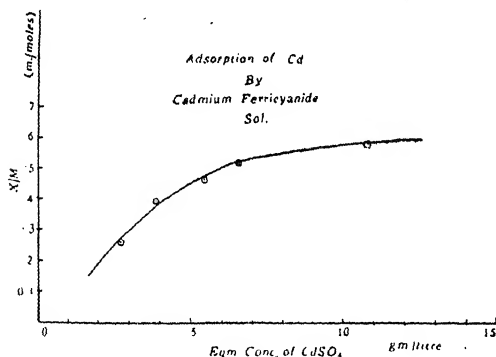


FIG. 2

There is a definite increase in the concentration of FeCy_6''' on successive dilutions even when the sol has been dialysed for 4 days.

The conditions of conductometric and thermometric titrations (*loc. cit.*) are similar to those for the formation of an undialysed sol, for one of the reactants is added in excess until the precipitate assumes the colloidal form. From the quantitative estimations of

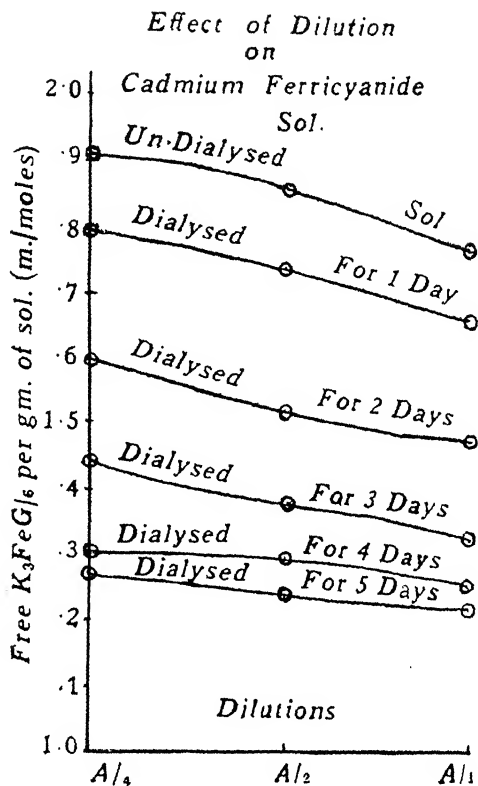


FIG. 3

hydrolysis and adsorption it is obvious that the variations in the composition of the compound are caused by both the factors.

Chemistry Department, HARISH CH. GAUR.
Agra College, A. K. BHATTACHARYA.
Agra,
March 28, 1950.

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STUDIES IN ANTIMALARIALS

Biguanido-aryl-sulphides and sulphones

FOLLOWING the discovery of the unique anti-malarial properties of Paludrine¹, many attempts have been made to improve upon the activity of the parent drug.^{2,3,4,5,6,7,8,9,10} Considering that a suitable substituted biguanide system may be sufficient for antimalarial activity,¹¹ we have prepared a series of $\text{N}^1\text{-N}^5$ -aryl substituted biguanides as possible antimalarials, by replacing the isopropyl group in paludrine and its bromoanalogue with chemotherapeutically active residues of 4-nitro-4'-amino diphenyl sulphide, 4-nitro-4'-amino diphenyl sulphone,

4, 4'-diamino diphenyl sulphide and 4, 4'-diamino diphenyl sulphone.^{12,13,14,15}

TABLE A

N'-N⁵-diaryl biguanides

RNH-C(=NH)-NH-C(=NH)-NHR', HCl

No.	R	R'	M.P. °C.
I	β -NO ₂ -C ₆ H ₄ -S-C ₆ H ₄ -	H	236-87
II	do	β -Cl-C ₆ H ₄ -	224-26
III	do	β -Br-C ₆ H ₄ -	220-22
IV	β -NO ₂ -C ₆ H ₄ -SO ₂ -C ₆ H ₄ -	H	238-39
V	do	β -Cl-C ₆ H ₄ -	207-8
VI	do	β -Br-C ₆ H ₄ -	223-25

TABLE B

4, 4'-Di (N'-aryl) biguanido diphenyl sulphide and sulphone

RNH-C(=NH)-NH-C(=NH)-NH-R'
 RNH-C(=NH)-NH-C(=NH)-NH-R'
 where R' = -C₆H₄-S-C₆H₄- and
 -C₆H₄-SO₂-C₆H₄-

No.	R	R'	M.P. °C.
I	H-	-C ₆ H ₄ -S-C ₆ H ₄ -	244
II	β -Cl-C ₆ H ₄ -	do	224-26
III	β -Br-C ₆ H ₄ -	do	232-33
IV	C ₆ H ₅ -	do	252-53
V	β -CH ₃ -C ₆ H ₄ -	do	192-93 (base)
VI	H-	-C ₆ H ₄ -SO ₂ -C ₆ H ₄ -	252 (decomp.)
VII	β -Cl-C ₆ H ₄ -	do	above 325
VIII	β -Br-C ₆ H ₄ -	do	278

Table A lists the products of condensation of arylcyanoguanidines with the appropriate arylamine hydrochloride by heating in equimolecular proportions in dimethylaniline at 120-40° C. for 2-4 hrs. The reaction products crystallised out as hydrochloride from the hot solvent. For the synthesis of compounds given in Table B, pyridine was used in place of dimethylaniline as solvent.

The chemotherapeutic activities (antimalarial and antitubercular properties) of the compounds are being tested.

Full details will be published elsewhere.

Organic Chem. Laboratories, A. C. ROY.
 Indian Institute of Science, M. RAGHAVAN.
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 April 3, 1950.

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THE INFLUENCE OF MANGANESE ON THE METABOLISM OF RATS AND ITS ALLEGED LIPOTROPIC ACTIVITY

The importance of manganese in the prevention of perosis of chicks has been amply demonstrated,¹⁻⁴ while its importance in the development of the bones of rabbits and to a much lesser extent, of the bones of rats, has also been shown by several workers.⁷⁻¹⁰

TABLE I

Influence of Zinc and Manganese on the Metabolism of Rats.

	Control	Zinc supplemented	Manganese supplemented
Food intake (gm.)	94.1	90.4	100.8
Increase in weight (gm.)	0.5	0.5	7.0
Uric acid in urine (mg.)	0.046	3.532	6.145
Creatinine in urine (mg.)	15.552	10.507	18.734
Total creatinine (mg.)	17.555	14.689	21.167
Nitrogen : (mg.)			
Urinary	191.55	127.38	252.09
Faecal	137.19	205.41	164.40
Retention	830.56	793.60	740.61
Phosphorus : (mg.)			
Urinary	93.27	52.84	114.06
Faecal	49.82	169.42	85.20
Retention	327.41	204.44	284.94
Liver Analysis :			
Fresh weight of liver (gm.)	5.968	4.965	6.545
Fat content (gm.)	1.281	0.785	1.533
Fat per cent.	21.43	15.81	23.03
Bone Analysis :			
Dry weight of femurs (gm.)	0.3615	0.3348	0.3723
Ash weight (gm.)	0.1801	0.1583	0.1915
Ash per cent.	48.76	47.42	51.53
Calcium (Ca) (mg.)	66.15	56.66	69.21
Phosphorus (P) (mg.)	38.05	33.05	39.90

Jukes⁵ and Jukes and Bird⁶ also showed that perosis is caused by a dietary deficiency of choline and of biotin.

Amdur, *et al.*,¹¹ have reported that manganese also possesses lipotropic activity. In view of the earlier reports^{12,13} that zinc possesses lipotropic activity and that it brings about poor development of the bones in rats by interfering with general metabolism, it was of interest to find out the influence of manganese on metabolism, fat content of liver and the development of the bones of rats fed on a high

fat, low protein diet, designed to produce fatty infiltration of liver. The supplements of zinc and manganese were made as 500 mg. per cent. of zinc oxide and 150 mg. per cent. of manganese chloride. These results are presented in Table I, which indicates the total for an experimental period of 21 days, divided into periods of three days each.

The results show that the influence of manganese on metabolism is almost just the opposite of that of zinc. The metabolism of both nitrogen and phosphorus is appreciably greater than in the other two groups and this appears to be made up by an increase in the food intake. There appears to be no evidence of a lipotropic activity of manganese, at least under the conditions of the present investigation, nor any marked improvement in bone development. The excretion of uric acid and of creatinine showed that manganese increased their output while zinc decreased it.

Details will appear elsewhere.

Haffkine Institute,
Bombay,
March 10, 1950.

V. SADASIVAN.

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A RAPID METHOD FOR ESTIMATION OF LEAF AREA IN GROWING MAIZE PLANTS

A METHOD of leaf area determination in barley described in another paper* leads to the formula

$\text{Log } \Sigma A = \text{Log } \Sigma L + \text{Log } \Sigma B - \text{Log } K - \text{Log } N$
which gives the total leaf area within three percent of the actual.

Leaf area in maize leaves is also found to be similarly related to the length and width of blade. The ratio $\left(\frac{\text{Length} \times \text{breadth}}{\text{Area}} \right)$ was

found to vary between 1.18–1.54 with an average of 1.32 for the total population of leaves. This leaf factor K is related to other leaf characters by the formula

$$A = \frac{L \times B}{K} \quad (1)$$

or, $\text{Log } A = \text{Log } L + \text{Log } B - \text{Log } K$, (2)
where A = leaf area of one surface, B = width of leaf in the middle of blade, L = length of leaf and K = leaf factor 1.32.

The total area on the plant can be had by measurement of total length (ΣL) and total width (ΣB) of all the N leaves, from equation:

$$\Sigma A = \frac{\Sigma L \times \Sigma B}{K \times N} \quad (3)$$

or, $\text{Log } \Sigma A = \text{Log } \Sigma L + \text{Log } \Sigma B - \text{Log } K - \text{Log } N$ (4)

Use of formula (2) for the individual leaf area or formula (4) for the total leaf surface involve an experimental error of 1.9 and 6.6 per cent. respectively. These formulæ are well adapted to the needs of biological

TABLE I

Relation between length and width of leaf and leaf area (all in cms.)

No.	Area in sq. cm.	Length cm.	Breadth cm.	Length × Breadth	Leaf Factor K	Calculated area (sq. cm.)
1	394.2	64.9	8.6	558.1	1.41	422.8
2	332.8	56.8	7.7	437.3	1.31	331.3
3	250.8	61.5	6.3	387.4	1.54	293.4
4	249.2	48.7	6.7	326.3	1.30	247.2
5	201.2	67.8	4.2	284.7	1.41	215.7
6	192.0	51.5	5.0	257.5	1.34	195.0
7	187.9	53.5	5.1	272.8	1.45	206.7
8	168.8	59.5	4.2	249.9	1.48	189.2
9	157.0	56.8	3.8	215.8	1.37	163.4
10	152.7	37.7	5.0	188.5	1.23	142.8
11	149.2	41.3	4.6	189.9	1.27	143.9
12	143.3	55.0	3.1	170.5	1.18	121.6
13	142.3	44.3	4.3	190.4	1.33	144.2
14	141.6	46.4	3.9	180.9	1.27	137.0
15	114.5	52.4	2.8	146.7	1.28	101.1
16	90.8	29.2	3.8	110.9	1.23	84.0
17	88.7	31.1	3.5	108.8	1.22	82.4
18	82.0	34.0	3.2	108.8	1.32	82.4
19	53.4	31.0	2.2	68.2	1.27	51.6
20	25.2	16.2	2.0	32.4	1.28	24.5
21	30.1	19.0	2.1	39.9	1.32	30.2
22	23.9	18.0	1.8	32.4	1.35	24.6
Total	3371.6	976.6	93.9	4558.1	29.14	3435.0

Average value of leaf factor K	1.32
Percentage error based on formula 2 ..	1.9%
Calculated area based on formula 4 ..	3147.0
Percentage error based on formula 4 ..	6.6%

investigation under field conditions, and are therefore recommended for rapid determination of total leaf area on growing maize plants.

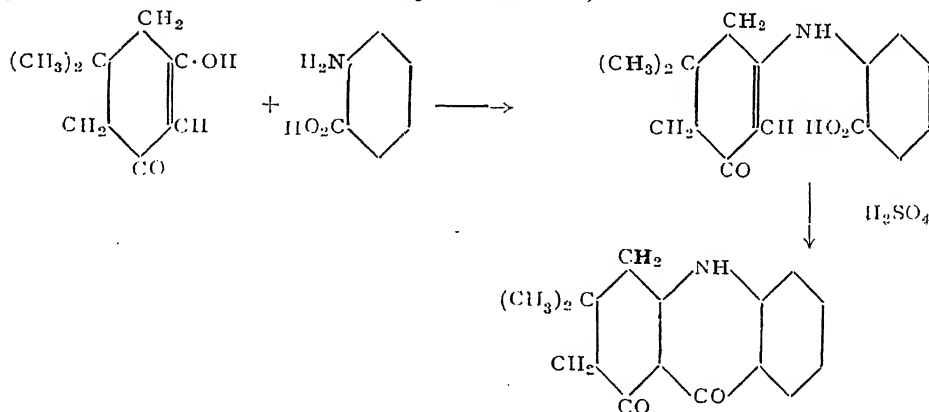
To do this (i) determine the leaf factor K on the sample of 25-30 leaves of different ages as indicated in Table I; (ii) estimate the total length ΣL , and total width ΣB of all leaves on the plant and (iii) apply formula (4) for total leaf surface. The entire estimation is finished within ten minutes. The method does not involve any costly appliance nor does it necessitate the removal of leaves. It is considered more helpful than any other advocated methods for rapid leaf area estimation.

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Benares Hindu University, M. S. SUBBA RAO.
March 27, 1950.

* Lal, K. N. and Subba Rao, M. S. *Sci. and Culture*, 1950, 15, 355-56.

STUDIES WITH METHONE: PART I

THE present work deals with the condensation of methone^{1,2,3,4,5} with anthranilic acids. The first stage of the condensation proceeds smoothly in the presence of absolute alcohol in the case of anthranilic acid, and in presence of dry pyridine in the case of *N*-methyl



N-phenyl and 4-methyl anthranilic acid, resulting in the formation of corresponding *N*-(3'-keto-5-dimethyl) (-3'-4-4'-5'-6'-tetrahydro) phenyl anthranilic acids. The second stage deals with the cyclisation resulting in the formation of the corresponding hydroacridones effected either by sulphuric acid (80%) or by heating methone and anthranilic acids directly on an oil-bath at 220° for 2 hrs. The yields are generally found good. The intermediate acids are yellow coloured crystals with definite

melting points whereas the cyclised products are amorphous and melt at 360°.

The reaction of anthranilic acid and methone can be detailed as shown by the structural formulæ

The phenyl hydrazones, 2:4-dinitro-phenyl hydrazones and the esters of the intermediate acid have been prepared and are tabulated below.

Methone ⁺	M.P.	Phenyl hydrazone	2:4-dinitro phenyl hydrazone	Ester
Anthranilic Acid		Yellow crystals	Yellow	B.P. 118-20°
1 Uncyclised	182°	186°	206°	
2 Cyclised	360°		225°	
<i>N</i> -Me. Anth. Acid				
1 Uncyclised	185°	180°	181°	
2 Cyclised	350°	226°		
<i>N</i> -Ph. Anth. Acid				
1 Uncyclised	200°	181°	194°	
2 Cyclised	350°	226°		
4-Me. Anth. Acid				
1 Uncyclised	206°	201°	204°	
2 Cyclised	310°	217°		

The authors' thanks are due to Professor P. C. Guha for his kind interest.

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March 27, 1950.

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2. Kleni, *et. al.*, *Micro. Chem.*, 1929, Pregl. First 204-34.
3. Chakravarti, *et. al.*, *J. Ind. Inst. of Sci.*, 1931, **14A**, 141-56.
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STUDIES ON LOCAL ANAESTHETICS

Part I

PREVIOUS work on local anaesthetics was confined for the most part to preparing esters of amino-aryl acids with different substituted alkanalamines. Substitution in the amino-

group of the acid component does not appear to have been tried. The preparation of a few derivatives of novocaine with acid chlorides of dicarboxylic acids is here reported.

Novocaine (2 mol.) was reacted in the cold with the di-acid chlorides (1 mol.) in benzene medium. The hydrochlorides of the resulting products separated out soon from which the bases were obtained by the addition of sodium carbonate solution.

ture of novocaine (4 mol.) and alkylene dibromide (1 mol.) in amyl alcohol for about 12 hours. On removal of alcohol, a dark pasty mass was left behind. It was treated with sodium carbonate solution and the liberated base taken up in benzene. The dry benzene solution on the addition of dry petroleum-ether gave a clear white precipitate.

The compounds are under pharmacological investigation.

TABLE I

Acid chloride used	Formula of the compound $R = -C_6H_4COOCH_2CH_2Net_2$	m.p. of the base	m.p. of the hydrochloride
1 Phosgene	.. $CO \begin{cases} NHR \\ NHR \end{cases}$	103°	217-218°
2 Oxalyl chloride	.. $CO \cdot NHR$ | $CO \cdot NHR$	218-19°	Chars without melting above 300°
3 Malonylchloride	.. $CH_2 \begin{cases} CONHR \\ CONHR \end{cases}$	83°	149°
4 Succinylchloride	.. $CH_2 \begin{cases} CONHR \\ CONHR \end{cases}$ | $CH_2 \begin{cases} CONHR \\ CONHR \end{cases}$	185°	230°
5 Glutarylchloride	.. $(CH_2)_3 \begin{cases} CONHR \\ CONHR \end{cases}$	132°	172°
6 Adipyl chloride	.. $(CH_2)_4 \begin{cases} CONHR \\ CONHR \end{cases}$	158°	185-90°
7 Phthalylchloride	.. $C_6H_4 \begin{cases} CONHR \\ CONHR \end{cases}$	98°	118°

In the cases of (4) and (7), in addition to the normal derivative, a small trace of an insoluble cyclic product was formed by the interaction of one mol. of novocaine with one mol. of the acid chloride melting at 242°-44° and 94° respectively.

The alkylene-bis-novocaine derivatives have been prepared by heating under reflux a mix-

TABLE II

Name of the alkylene dibromide	Formula of the derivative	m.p. of the base	m.p. of the hydrochloride
1 Ethylene dibromide	$C_2H_4(NHR)_2$	185°	240°
2 Trimethylene dibromide	$(CH_2)_3(NHR)_2$	189°	261° Chars
3 Tetra methylene dibromide	$(CH_2)_4(NHR)_2$	197°	above 270°
4 Pentamethylene dibromide	$(CH_2)_5(NHR)_2$	223°	„

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STUDIES ON LOCAL ANAESTHETICS Part II

To study the effect of replacement of the amino-group of novocaine by groups like urea, thiourea, cyanamide, guanidine and amino-guanidine, etc., the following compounds as shown in Table I have been prepared.

The urea derivative (I) is prepared by the action of potassium cyanate on novocaine in excess of dilute acetic acid. The thio-carbamido derivatives (II-VIII) are prepared by condensing the corresponding isothiocyanates with novocaine in a suitable organic solvent. The acetyl and benzoyl thio-carbimides obtained by boiling the acid chlorides with lead thiocyanate in anhydrous benzene, reacting with anhydrous novocaine furnish the corresponding acetyl and benzoyl thioureas (IX and X).

TABLE I

No. of compound	Formula of the compound $R = -C_6H_5-COOCH_2CH_2-NEt_2$	M.P. °C.
I	$NH_2-CO-NH-R$	84°
II	$PhNH-CS-NH-R$	152°
III	$p\text{-Cl. } C_6H_4-NH-CS-NH-R$	132°
IV	$p\text{-Br. } C_6H_4-NH-CS-NH-R$	138 (decomp.)
V	$p\text{-I. } C_6H_4-NH-CS-NH-R$	178 (decomp.)
VI	$p\text{-Me. } C_6H_4-NH-CS-NH-R$	119
VII	$o\text{-Me. } C_6H_4-NH-CS-NH-R$	109
VIII	$m\text{-Me. } C_6H_4-NH-CS-NH-R$	103
IX	$CH_3CO-NH-CS-NH-R$	132
X	$PhCO-NH-CS-NH-R$	152

The compounds are under pharmacological investigation.

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ROOT DEVELOPMENT AND YIELD OF *LYCOPERSICUM ESCULENTUM* MILL. VAR. *BEST OF ALL* IN RELATION TO VARYING MOISTURE SUPPLY

BOYNTON (1936) reported that fruit growth was reduced on trees with root system only 2' deep while trees rooting 4' deep were unaffected. Water in the third and fourth foot was responsible for maintenance of fruit growth on deeper rooting trees. Magness, Degman and Furr (1935) reported serious difficulties in apple trees rooting to a depth of only 18". They concluded that since water is lost by evaporation from the soil to depth exceeding 12", the moisture available for the trees in such a location would be sufficient for a short drought only.

Materials and Method.—The experiment under report was laid out statistically for studying the growth and yield of *L. esculentum* var. *Best of All* under four depths of irrigation, viz., $\frac{1}{2}$ ", 1", 2" and 3" every fortnightly. For study of root development four plants of uniform size from each treatment were selected.

Direct method of root study was applied. At a convenient width all round the plants to be examined, a ditch was dug to a depth of 5'. The soil around the plant was then gradually washed away by a force pump. As the work

of excavation progressed, the trench was deepened if necessary so that, finally the soil underlying the deepest root was removed. As the process continued, detailed notes, careful measurements and drawings were made in the field on a large drawing sheet. In the drawings, the roots were arranged as nearly possible in a vertical plane. Although the drawings were made on a large scale, the rootlets were often so abundant that it was quite impossible to show the exact number. Such drawings, however, represent the extent, position and natural branching of the root system even more accurately than a photograph in which the details of the extensive root system are always obscured.

Experimental findings :—

1. Relation of absorbing area to soil moisture :

A. Root development under $\frac{1}{2}$ " irrigation.—The tap root after entering the soil to a depth of a few inches gave rise to a lateral root which penetrated to a depth of nearly 4.5'. This lateral gave rise to four secondary branches on its right side at approximate distances of 0.7', 1.5', 1.9' and 2.4' respectively in descending order.

The tap root again went vertically down to a depth of 1' when it gave rise to four lateral branches. Thus, five lateral branches arose from the tap root within 1.5' from the surface

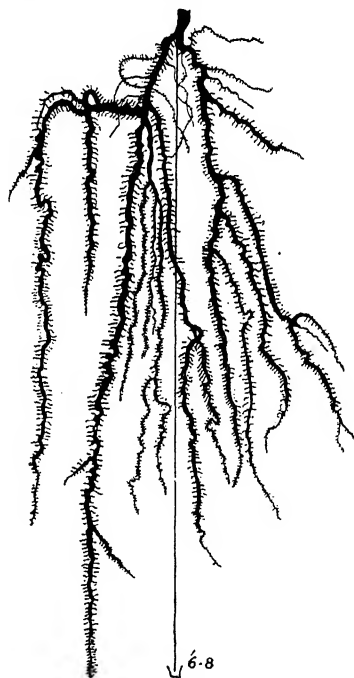


Plate No. I. Showing the root development under $\frac{1}{2}$ " irrigation.

soil. The laterals, however, gave rise to other secondary and tertiary branches. The tap root, however, penetrated to a depth of 6.8' (Plate No. I).

B. Root development under 3" irrigation.—Under 3" irrigation great number of roots were found at the base of the stem. Many of them were only 1" to 4" in length, and highly branched. The branching was also profuse in the upper 6". Sometimes the ultimate branchlets were 0.3" to 1" in length. The tap root entered the soil horizontally but immediately pursued a downward vertical course and penetrated upto 4.3' depth and gave rise to two laterals, of length 3.8' and 5.1' respectively. The lateral measuring 5.1' gave rise to two sub-laterals originating at the depth of 0.2' and 2.5' on its right and left respectively. The sub-lateral originating on the right side again gave rise to further branching, the deepest penetration being 3.1' from the place of its origin. The deepest depth from the surface of the soil was 4.0'. The sub-lateral from the left side at the depth 2.5' had its maximum vertical penetration of about 1.2'.

The other lateral measuring 3.8' gave rise to several other sub-laterals, the deepest depth of one of these was 2.7' (Plate II).



Plate II. Showing the root development under 3" irrigation.

The root development under 1" and 2" irrigations were more or less similar. The tap root under 1" irrigation was 5.6' with four major laterals while in case of 2" irrigation the tap root measured 5.4' with same number of laterals.

C. Dry weight of roots.—The roots were thoroughly washed and dried in an oven to

constant weight at a temperature of 65 to 70 °C. (at the higher temperature charring of the finer roots took place).

TABLE I
Showing the relative dry weight of roots
(average of four plants of each treatment)

Treatments	Average total dry weight	Percentage difference
A. $\frac{1}{2}$ " irrigation	21.220 gm.	119.12
B. 3" irrigation	9.684 gm.	

Thus it is evident that there is considerable difference not only in the depth of penetration of the tap and secondary roots under light and heavy irrigations but also in the dry weight, the percentage difference being 119.12.

II. Yield in relation to root system.—Table II gives the records of yields under different depths of irrigations and corresponding root development.

TABLE II
Showing the relation between yield and root development

Treatments	Average depth of tap root	Average number of laterals	Average total dry weight	Mean yield per plot ($15' \times 34'$)	Probable error
$\frac{1}{2}$ " irrigation	6.8'	5	gm. 21.220	srs. 238	S.E. of difference = 11.02 srs. Critical diff. at $P = .05 = 24.885$ srs.
3" irrigation	4.1'	2	9.684	193	

The average yield was significantly greater under $\frac{1}{2}$ " irrigation when the root system was deeper and more penetrating than in the other.

The inference is:—(i) under excessive irrigation, the top development of tomato roots is considerably greater, but the branches are short, and end abruptly. They are, however, abundant and more profuse in the first foot of soil. Only a few major branches descend vertically to supplement the absorbing area of the tap root.

(ii) Under light irrigation, the root system is not so widely spread in the upper region, but penetrates much deeper, upto 7.2', and the roots are comparatively thicker. Thus, the vertically penetrating roots enter the deeper

layers of the soils, and probably contribute to the increase in yield.

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April 12, 1950.

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EFFECT OF SHORTENING THE DAILY LIGHT PERIOD IN THE MORNING AND IN THE EVENING, IN SHORT-DAY TREATMENT OF JUTE

It has been found previously^{1,2} that both the species of jute *C. capsularis* L. (D 154) and *C. olitorius* L. (C.G.) behave as short-day plants.

In an experiment with the two species to compare the effect of shortening the daily light period in the morning hours following sunrise and in the evening hours before sunset in the 8 hours and 10 hours light period treatments, one set of plants was darkened in the morning commencing at sunrise and the other set in the evening ending at sunset, the periods of darkening in the ventilated dark room in both the cases being adjusted to provide for the required periods of light. The plants were sown on 17-4-1948, in earthenware pots of 13" diameter and 13" height, and there were 12 plants per treatment grown in 3 pots with 4 plants each. The flowering time taken as the date of initiation of first visible flower-bud and the fruiting time as the date of initiation of first visible fruit and the heights in cm. at flowering were noted separately for each plant and recorded as mean of 12 plants in Table I for *C. capsularis* and Table II for *C. olitorius*.

It will be seen that plants darkened in the morning in the 8 hours treatment flowered much later than those darkened in the evening, the difference in the case of 10 hours being not so prominent. The heights at flowering are however not very different in the two types of treatment under each light period. All the plants produced flowers and fruits, but only 41.67% of the plants that flowered under 8 hours treatments darkened in the morning produced fruits. In general the plants exposed to darkness during morning hours gave a sickly appearance as the leaves were not properly developed near the apex. Many of them became deformed by curling and were shed in large number. This was more clearly visible in the 8 hours treatment.

TABLE I. *C. capsularis*

Flowering and fruiting times and heights at flowering of plants darkened in the morning following sunrise and darkened in the evening before sunset.

		Height in cm.		Flowering time		Fruiting time days
		Mean	S.E.	Mean	S.E.	
8 hrs.	Dark in the morning	47.87	±2.04	55.59	±1.67	66.2 41.6%
	Dark in the evening	46.96	±5.75	37.17	±.344	50.4
10 hrs.	Dark in the morning	46.16	±1.53	35.09	±.336	46.9
	Dark in the evening	49.78	±2.19	33.59	±.484	44.6
Normal (control)		182.23	±4.75	130.92	±.763	150.6

TABLE II. *C. olitorius*

Flowering and fruiting times and heights at flowering of plants darkened in the morning following sunrise and darkened in the evening before sunset.

		Height in cm.		Flowering time		Fruiting time Days
		Mean	S.E.	Mean	S.E.	
8 hrs.	Dark in the morning	45.30	± 6.21	54.62	±4.23	44.0* 8.3%
	Dark in the evening	5.59	± .251	24.59	± .149	35.7
10 hrs.	Dark in the morning	47.05	±10.37	44.5	±4.83	63.2
	Dark in the evening	11.02	± .391	21.0	± .213	30.2
Normal (Control)		242.56	± 7.46	125.7	± .891	144.7

* One plant of this treatment flowered much earlier than others in 25 days and this plant produced a small number of fruits. The others which flowered later did not produce any fruits, hence the fruiting time recorded for one plant here is earlier than the recorded mean flowering time.

In *C. olitorius* the plants darkened in the morning were very much affected and the leaves were not properly formed, and many of them near the apex were curled. Their leaves did not develop the normal green colour and a large number of them were shed. In this species the flowering time of the plants darkened in the morning both in 8 hours and 10 hours treatments is much longer than those darkened in the evening, the heights at flowering of the set darkened in the evening are comparatively much shorter than those darkened in the morning, and the differences are much more prominent than in *C. capsularis*. The plants treated for 8 hours and 10 hours periods and darkened in the morning required a longer period to produce fruits than those darkened in the evening in this species. Plants under 8 hours treatment darkened in the morning failed to produce fruits except in one plant out of 12.

The delay in flowering as also the diseased condition in the sets which are darkened in the morning compared with those darkened in the evening show that when the darkening is done in the morning hours, the normal harmonious nutrition and growth balance of the plants is disturbed, and also that the production of the flowering hormone is retarded, more clearly in the case of 8 hours treatment and in *C. olitorius*.

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April 28, 1950.

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1. Sen Gupta, J. C., and Sen, N. K., *Journ. Ind. Agric. Sci.*, 1946, **14**, 196-202. 2. —, *Nature*, 1946, **157**, 655-56.

CHROMOSOME DIMINUTION IN A PLANT ROOT

In the course of paddy breeding, a hybrid between *Oryza sativa* ($2n = 24$) and *Oryza eichingeri* ($2N = 48$) was produced at the Paddy Breeding Station, Coimbatore. This hybrid is completely sterile and has been maintained over a course of years by vegetative propagation. Counts of chromosome numbers in the root tips of this plant, gave the expected number 36. However, chromosome numbers fewer than this were also counted in intact cells. Therefore more sections were prepared and counts made from undisturbed metaphase plates. The counts made showed that in some cells the number is diminished. In every fresh planting of this

hybrid stubble, the root initials do start with 36 chromosomes, but in the older portions of the root, the number falls to 34, 33, or 32 chromosomes. Figs. 1 and 2 are camera lucida drawings from two cells, and they show the type of preparations from which the observations were made. The diminution is at random, and has been observed in cells of the plerome, and not in those of the dermatogen. The mitotic mechanism by which such diminution occurs could not be determined.

In order to find out if this feature was controlled by the environment, the hybrid stubble was rooted in washed monazite sand from Travancore, having a thorium content of 9%. The root growth was vigorous in this sand. In the sections, details of mitosis showed slight differences from those in soil grown roots. In the monazite grown roots, the chromosomes were less contracted and counting them was more difficult. However chromosome diminution was noticed in this culture also. Exact comparisons could not be made owing to the crowding together of the small chromosomes in metaphase plates.



1



2

Study of literature showed that there are other records of similar exceptions to the general principle, that all the cells of an organism possess the identical chromosome complement. Huskins¹ has shown that the principle cited is an over-simplification and has also drawn attention to proved exceptions. He has also shown that chromosome diminution can be brought about artificially, and that 2% solution of sodium nucleate can cause reduction of chromosomes in growing roots. Muntzing² has also recorded that 'B' chromosomes are largely eliminated in the somatic tissues of a *Sorghum*, and that this elimination is detectable even in the embryo. In *Pennisetum polystachyon* (Dry Napier grass or Thin Napier grass) I have observed a marked chromosome diminution to occur in secondary roots. In this natural polyploid the somatic number is 54, and counts as low as 34 have been made by me.

An explanation of this diminution cannot be advanced until more data is available. This

observation is recorded to show that there is an unexpected source of error in determining chromosome numbers of polyploids from root tips.

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May 12, 1950.

1. Huskins, C. L., *Hereditas, Lund.*, 1949, *Suppl.* 35, 274-85.
2. Muntzing, A., *Ibid*, 408-09.

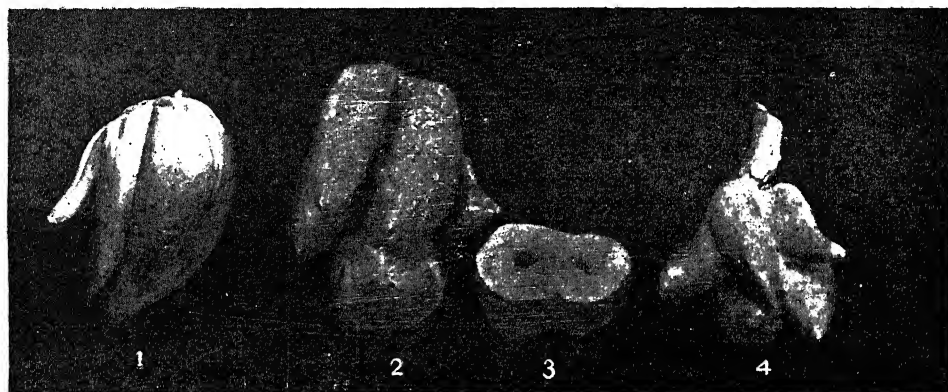
HALF-APOCARPY IN *CARICA PAPAYA* LINN.

THE fruit in *Carica papaya* Linn. is developed from a syncarpous ovary of five carpels with parietal placentation. Normally, the style is single, but very short carrying five laciniated stigmatic lobes. Apocarpous fruits have been noticed on a plant at the Botanic Garden at Coimbatore. In papaw, the internal proliferation has been recorded by Bergman (1921), Sayeeduddin and Bari (1936) and Khan (1946), and viviparous germination is a common feature; but the apocarpous nature, we believe, is being recorded here for the first time.

dependent stigmatic lobe; this and the distribution of the placentas in the locules prove that the carpels are apocarpous and not syncarpous with a single locule. Since the carpels are fused at the base and free towards the ends, it is described here as 'half-apocarpous'. Similar instances have been recorded by Wordsdell (1916) in orange and lemon where the dissociation of the carpels ('quarters') gave rise to curious fingered fruits with the carpels united at the base.

It is generally recognized that the most primitive type of pistil is the apocarpous one. The present instance of dialysis of the carpels resulting in half-apocarpy is probably a case of reversion. As the plant produces fruits which are mostly of the type described above, it will be of interest to see whether this character is repeated in the progenies.

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The fruits of this plant are mostly abnormal with varying numbers of "finger"-like projections (Fig. 1 to 4). A few normal fruits are also formed. Fig. 3 shows the section of a fruit which looked like two fruits having fused together for outward appearance; but the section revealed five placentas distributed in the two locules. The bigger chamber has three placentas showing that it is of three carpels and the smaller with two placentas. Some of the fruits had five distinct fingers (Figs. 2 & 4) and each finger is a carpel with a small locule.

Closer examination of the flowers and developing young fruits showed that the pistil had initiations for the apocarpous condition in the early stages itself. Each 'finger' carried an in-

1. Bergman, H. F., *Bot. Gaz.*, 1921, 72, 97-101.
2. Khan, A. S., *Sci. and Cult.*, 1946, 12, 194.
3. Sayeeduddin, M., and Bari, A., *Curr. Sci.*, 1936, 4, 740-41.
4. Wordsdell, W. C., *The Principles of Plant Teratology*, Ray Society, London, 1916.

INTEGUMENTARY VASCULAR TISSUE IN *CASSIA TORA* LINN.

In the majority of angiosperms, the vascular strand of the funiculus enters the ovule and ends in the region of the chalaza. Instances are, however, known where it extends beyond the chalaza, entering the integument and extending as far as the region of the micropyle. Such integumentary bundles have been report-

ed in a number of dicotyledonous families and are almost always restricted to the outer integument. Netolitzky¹ has cited among others, a few members of the Papilionaceæ as showing this condition. During an embryological study of *Cassia Tora* (N.O. Cæsalpiniaceæ), the author found very prominently developed vascular strands in the outer integument of the developing seed. At the time of fertilisation the vascular strand that supplies the ovule stops short at the chalaza but with further development strands of elongated cells appear in the outer integument and they organise themselves into distinct vascular elements (Figs. 1, 2). They are, however, not associated

Grateful thanks are due to Prof. P. Maheshwari of the Delhi University for valuable suggestions.

Dept. of Botany, M. ANANTASWAMY RAU.
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Mysore City,
April 20, 1950.

..I. Netolitzky, F., *Anatomie der Angiospermen-Samen*, 1926, Berlin.

CHLOROZOL FAST PINK, B.K.S., AS AN ANTICOAGULANT IN EXPERIMENTAL PHYSIOLOGY

In searching for a suitable alternate anti-coagulant for Starling's Heart Lung preparation, choice fell upon chlorazol fast pink B.K.S., No. 353 in the colour index. Jorpes¹ mentions many points in favour of this dye which, according to him, is in some ways better than Heparin. Kahlson and Landby² have made a detailed study of its use in Experimental Physiology. However, the exact effective dose could not be ascertained from available literature, and had to be determined by trial.

To 0.5 c.c. of different dilutions of the dye was added 4.5 c.c. of blood from the carotid artery of a dog under paraldehyde anæsthesia, mixed quickly, and the coagulation time noted. It was found that a concentration of 1.7 mg. of the dye per c.c. of blood prevented coagulation *in vitro* for over 6 hours. Taking the amount of blood in the dog as 8% of the body weight, this worked up to 0.13 gm. per kg. body weight. To allow for a slight diffusion into the tissue fluids, and to have a margin of safety for experiments involving surgical operations, it was decided to use 0.2 gm. per kg. body weight. Two dogs under paraldehyde anæsthesia were injected intravenously with 4% solution of the dye in normal saline solution calculated at the above dosage. Blood was removed from one of them and used to fill the apparatus, while the other was used as the experimental animal. The dye was found to be non-toxic and effective at the above dosage besides being also cheaper than Heparin and easily procurable. With it, the Heart-lung preparation works very well.

Dept. of Physiology, K. N. GOVINDAN NAYAR.
Madras Veterinary College,
May 5, 1950.

1. Jorpes, J E., "Heparin," Its Chemistry, Physiology and Application in Medicine, Oxford. 2. Kahlson and Landby, quoted by Jorpes.

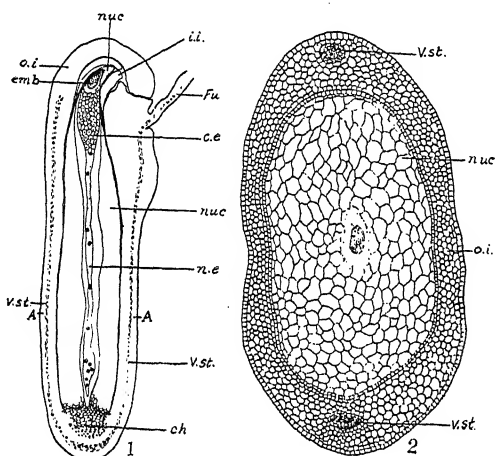


FIG. 1. L. S. of developing seed showing vascular strand in outer integument. $\times 18$.

FIG. 2. Cross-section taken at level AA indicated in Fig. 1 showing vascular supply of developing seed. $\times 67$. (fu., funiculus; o.i., outer integument; i.e., inner integument; nuc., nucellus; emb., embryo; c.e., cellular zone of endosperm; n.e., free nuclear zone of endosperm; v.st., vascular strand; ch., chalaza).

with any specialised structures like sclerenchyma fibres, pigmented cells or oxalate crystals as is often the case in the instances mentioned by Netolitzky.¹ The appearance of such vascular strands in the outer integument during the post-fertilisation stages is perhaps partly due to the increased demand for a conducting system on account of the enormous increase in size of the ovule.

Preliminary observations indicate the occurrence of similar integumentary vascular bundles in other species of *Cassia* and in *Parkinsonia aculeata*, also a member of the Cæsalpiniaceæ. A fuller account of the embryology of these species is being published elsewhere.

REVIEWS

New Directions in Science Teaching. By Anita D. Laton and S. Ralph Powers. (McGraw-Hill Book Company, New York), 1949. Pp. 164. Price \$ 2-50.

One of the main defects in the present-day educational system is that it is too academic and uncorrelated to the environment and the needs of the community. The teaching in Schools and Colleges is largely stereotyped and based on set-syllabuses for a cluster of subjects, with neither elasticity in subject-syllabuses nor any co-ordination between syllabuses of different subjects. Educational reforms based on committees and questionnaires usually take the form of a regrouping of subjects or recasting of syllabuses or both. Such a reshuffling of courses often results in leaving out the essential reform, namely correlating the education of the young to the changing times and growing needs of the community.

A new method of approach based on investigation and researches in the teaching of sciences at the secondary school level was made by the Bureau of Educational Research in Sciences in U.S.A. since 1935, with the active co-operation of seventeen selected schools in the States. The work of the Bureau may be divided into three major intervals: (1) Period of Exploration, 1935-38, (2) Preparation for Teaching Suggestions, 1938-40 and (3) Application to class-room practice, 1940-43. During the first interval specialists in several fields of learning—Biology, Chemistry, Physics, Philosophy—worked together to determine the aim of scientific education in relation to the life of the people. The goal of the second interval was to develop methods of teaching by which the aim so determined is achieved. Expert teachers worked in the Bureau and prepared 'Suggestions for Teaching'. In the third interval effort was made to translate the work of the two phases into actual class-room practice. The book under review describes the work done in the third interval.

Seventeen Schools co-operated in the project. The representative teachers from the Co-operating Schools worked together in Summer Workshops during 1940-43, to extend their own education in areas in which they work and also to prepare teaching materials suitable to the maturity levels of their classes. The planning was based on the assumption that the function

of the school is to present opportunities for young people to achieve a *useful* education, that is an education recognised by the students as suitable to their needs. The Summer Workshops were characterised by general meetings, special lectures, group conferences and field trips. In these courses and in their schools through the year, teachers made individual study of the resources and the people of the community in which they are teaching and in which their students are likely to live; study of the young people—their needs, their characteristics, their vocational interests, their standards of conduct and family relationships; and study of the current problems affecting the nation and the individual such as intercultural relations, personal health, uses of material and energy, economic trends, etc. All the co-operating teachers gained new perspectives and new knowledge in the teaching of the young. With these experiences they were able to develop new courses of study in biology, physical sciences and experimental chemistry and plan interdepartmental courses such as an integrated course of science and social studies, of Science and English, of American history and chemistry, of chemistry and economics, of biology and home nursing, etc. Their study also resulted in new emphases within existing courses—such as the emphasis on human development and growth in biology classes; on the study, utilisation and conservation of natural resources in the science courses; and on the place of man in the Universe in the Astronomy classes. The book under review gives a descriptive report on the changes in the curriculum and in the method of teaching of science in schools and also an estimate of the changes in the young people and in the teachers who participated in the working of the scheme. A perusal of the book will no doubt be stimulating to those who are concerned with the teaching of the younger generation, and the reorganisation of education in the country.

C. S. V.

Progress in the Theory of the Physical Properties of Glass. By J. M. Stevels. (Published by Elsevier Publishing Company), 1948. Pp. xi+104. Price 10 sh. net.

This is one of the monographs on the progress of research in Holland during the war. Due to

the exigencies of war D. J. M. Stevels, who is an authority in glass technology, was forced to divert his attention from experimental to the theoretical study of the properties of glass. This book records the results of his investigation and represents a considerable advance in the knowledge of the structure of glass.

The first chapter is in the nature of a general introduction where the concepts of Zachariasen and Warren on the structure of glass have been elucidated. The four chapters that follow are entitled: Density of Glass, the Electrical Conductivity of Glass, the Dielectric losses of Glass and the Molecular Refraction of Glass. In each chapter the author describes the various physical methods for the investigation of the structure of different glasses. The studies of the constitution of these glasses are based on fundamental physical concepts and the application of these leads to the classification of glasses as *normal* and *abnormal*. The author accounts for the abnormalities by postulating structural differences.

The volume will be found very stimulating not only to those who are actively engaged in the investigation of the structure of glass but also to those interested in the larger domain of the physics of the solid state of matter.

S. RAMASESHAN.

Experimental Physical Chemistry. By Farrington Daniels, J. H. Mathews, J. W. Williams, P. Bender, G. W. Murphy and R. A. Alberty. International Chemical Series. (McGraw Hill Book Company, New York), New fourth Edition, 1949. Pp. xiii+568. Price \$ 4.50.

The first edition of this well-known book appeared in the names of the three senior authors in 1929. In the preparation of each of the subsequent new editions "there have been two major objectives: to keep pace with the new developments in physical chemistry, and to keep the book always representative of the teaching of the laboratory course in the subject at the University of Wisconsin". This has been facilitated by the more recent collaboration of three younger members of the professoriat, who are "somewhat closer to the problems of the laboratory instruction". The advantages of this kind of collaboration need scarcely be stressed, and such co-ordination has become a very pleasing feature of some of the recent American publications.

Part I of this book with 15 chapters deals with a variety of experiments under 64 different topics, which besides routine exercises

include those on dielectric constant and dipole moment, photochemistry, Raman effect, chromatography, and radioactive tracer technique. Part II with 11 chapters deals with apparatus and methods with a discussion of errors of measurement.

As far as the exercises are concerned, the claim to keep pace with the new developments in physical chemistry has been fully justified, and no important topic has been left out. The title however may be a little misleading. "Experimental Physical Chemistry" should not be taken as equivalent to "Practical Physical Chemistry". In the Preface to the first edition the authors remark: "The imperative is not used. Procedures are described but orders are not given. The student must study the experiment first and then set his own pace..." In other words there is no "spoon-feeding", for which reason this is not a beginner's book. A student who attempts to carry out physical chemistry experiments for the first time with the aid of this book alone without assistance from an instructor can scarcely hope to make much progress in a reasonable time. To give an illustration, it is very doubtful if a student can carry out successfully with the directions given on pages 174-75 a determination of "Transference Number". It has been the experience of several teachers that in such cases a worked-out example with all the relevant observations is the best method of initiating the student in the experiment. Of course the instructor can help. But in a class with a large number of students engaged in different kinds of exercises this will be a great strain on him.

On the other hand, in this book wherever more experimental details are required complete references are given. In the case of "Transference Number" mentioned above besides the Hittorf method, the moving boundary method is also described with the essentials of the theory and experiment, and more important still, with the latest references. This applies to all exercises dealt with. The book is an excellent one and can be recommended to all teachers and advanced and research students who wish to have a ready reference book for routine experiments as well as the latest techniques in physical chemistry. M. R. N.

Vacuum Tube Amplifiers. Edited by George E. Valley and Henry Wallman. (Vol. 18 of Radiation Laboratory Series; McGraw Hill Book Co. Inc., N.Y.), 1948. Pp. 743. Price \$ 10.00.

The volume under review is devoted to a detailed consideration of the several problems

that call for attention and solution in the design and application of vacuum tube amplifiers for the different functions to which they have been put to in recent years. The amplifiers discussed in this volume are instances of extreme performance value with reference to one of the several characteristics namely, bandwidth, sensitivity, linearity, constancy of gain over long period, etc.

The first chapter is devoted to "Linear Circuit Analysis and Transient Response". This includes the mathematical analysis of the theory of the Laplace Transform and its application in the solution of network problems. Towards the end of the chapter there is a section, summarising the use of L-Transform in network problems. This will be highly appreciated by readers who are more keen on utilising the Laplace Transform as a tool in solving practical network problems than in following the analysis of Laplace Transform theory itself. This chapter also includes examples of the use of L-Transform theory to solve practical network problems.

Chapter 2 is devoted to the analysis of amplifiers of direct pulse, where the emphasis is on their high fidelity characteristic as contrasted with large dynamic range pulse amplifiers discussed in the following chapter. The investigation of the rectangular pulse is considered in two distinct parts, namely, the reproduction of the leading and the trailing edges and the reproduction of the flat top. Special two-terminal and four-terminal circuits are discussed which possess the characteristic of low rise-time and over-shoot which are essential requirements from the point of view of faithful reproduction of the leading edge of the pulses. Similarly, the effects of the different parts of the circuit on the flat-top response are considered together with the schemes for compensating for the sag that would otherwise occur. This chapter also includes sections on inverse feed-back, gain-control, and mixing of multiple input signals in such pulse amplifiers. Further, there are also sections devoted to limiting amplifiers, electronic switching of pulse amplifiers and the output stage of such amplifiers. Lastly, this chapter also includes two examples of pulse amplifiers, one of which is designed for deflection-modulated cathode-ray tube and the other for intensity-modulated cathode-ray tube.

Pulse amplifiers of large dynamic range are discussed in an equally detailed style in Chapter 3.

Wide-band, high-frequency band-pass amplifiers are discussed in Chapters 4 to 8; the last of these chapters is devoted to "Amplifier Measurement and Testing" including a section on undesired regeneration effects in Band-Pass amplifiers.

Chapter 9 discusses low-frequency amplifiers with stabilised gain, which is the chief characteristic required by computer amplifiers. The gain of such an amplifier must be held constant within closely prescribed limits regardless of the variability of vacuum-tube parameters, the manufacturing tolerances of passive components, etc. Inverse feedback circuits that can be employed to achieve the desired constancy of gain with respect to circuit parameters are analysed. Illustrations of the design of computer amplifiers are also included.

Chapter 10 is devoted to the consideration of frequency-selective amplifiers of low-frequency range.

Direct-coupled amplifiers which have several fields of application such as vacuum tube voltmeter, cathode-ray oscillograph, D. C. Servoamplifiers, etc., etc., are discussed in great detail in Chapter 11, treating all problems peculiar to such amplifiers.

Chapter 12, 13 and 14 deal exhaustively with the subject of noise. The first of these chapters develops the subject in a rigorous theoretical manner. The next chapter discusses the points to be borne in mind while designing amplifiers for best signal to noise ratio. The last chapter explains the experimental measurement of noise figure in amplifiers, which also is an estimate of amplifier sensitivity.

Each of the above chapters is written by one or more authors, who, in the course of their work, have had occasion to study deeply the particular branch to which the chapter pertains to. Consequently the entire volume is masterly in the presentation of both theoretical and practical aspects of varied types of vacuum-tube amplifiers included in this volume.

This book will serve as a very useful guide to research workers and Electronics Engineers who may be working on special type of amplifiers as distinct from the common audio and R. F. amplifiers.

B. N. PRAKASH.

Allergy. By Arthur F. Coca and eight other authors. *The Annals of the New York Academy of Sciences*. Vol. 50, Art. 7. (New York: Published by the Academy), December 26, 1949. Pp. 679-814. Price \$ 2.50.

The publication is a collection of papers on the controversial subject of allergy, presented

by workers who are actively engaged in this field of investigation. The monograph covers various aspects of the subject, *viz.*, atrophy, contact dermatitis, serum allergy, drug allergy, hypersensitiveness of infection, familial non-reaginic allergy, etc.

In the introductory paper on experimental anaphylaxis in lower animals, Seegal presents some means of experimental sensitization which may also operate in human allergies. The varieties of the manifestation of experimental anaphylaxis have been described with the purpose of bringing out similarities between these diseases and the natural allergic disease of man.

This is followed by several papers discussing the various aspects of the allergic diseases, experiments and demonstrations in these diseases and modes of alleviation and cure. These reveal much valuable information on the different manifestations of allergy, its relation to immunity and the familial nonreaginic allergy. Discussing the allergy of infection Seegal concludes that with the newer methods of immunochemistry, the problems of allergies of infection and their relation to immunity will be clarified. Familial nonreaginic food allergy or "idioblapsis" owes its name to Dr. Arther F. Coca. Meyer has examined this highly controversial subject critically and has presented a paper in an attempt to explain the rationale of the conclusion that there is an extraneous factor which not only precipitates a disordered mechanism of bodily function but also renders the organism susceptible to the ravages of certain infection agents. The paper is divided into three sections (1) theory, (2) practical application, (3) results obtained. By this presentation, the author hopes to prove the existence of idioblapsis as an entity.

Coca in his paper on "the anti-allergic action of sympathectomy" gives a brief critical review of the literature concerning sympathectomy and sympathetic procaine-block. According to the results of his study of the antiallergic effect of sympathectomy, the author emphasises that the operation should no longer be considered as a therapeutic measure for the relief of particular symptoms but almost always a means of lessening the extent and severity of the food allergy that causes them and so facilitating its complete dietary control.

The publication is a valuable addition to the literature on allergy.

N. N. DE.

Advances in Carbohydrate Chemistry, Vol. 3.
Edited by W. W. Pigman and M. L. Wolfrom.
(Academic Press, Inc., New York), 1948.
Pp. xxiii + 424. Price \$ 8.50.

The third volume of this excellent series on the compilation and critical presentation of various themes in carbohydrate chemistry was published in 1948 and should by now be familiar to every teacher and research worker in this field. The present treatise maintains the high standard of its predecessors. There are eleven essays providing authoritative and carefully integrated information on a wide range of topics. These include: Conventions used for writing stereo-formulae in a plane (C. S. Hudson); Reactivity of the hydrazone and osazone derivatives of sugars (E. G. V. Percival); Configuration of the cyclitols (H. G. Fletcher, Jr.); Trityl ethers of carbohydrates (B. Helferich); Unfermentable reducing substances in cane molasses (L. Sattler); and, Halogen oxidation of simple sugars (J. W. Green). The book also contains timely and instructive chapters on: The molecular constitution of cellulose (J. Compton); Use of isotopes as tracers in the study of carbohydrate metabolism (S. Gurin); Enzymic degradation of starch and glycogen (K. Myrbäck); Polysaccharides of *Mycobacterium tuberculosis* (M. Stacey and P. W. Kent); and, Chemistry of streptomycin (R. U. Lemieux and M. L. Wolfrom).

Publications, such as this series of 'Advances', representing well collated surveys of recent literature and stimulating articles of great general interest, by recognised authorities on the different specialised branches of the subject, are bound to serve as invaluable aids to student, teacher, and investigator alike.

A. SREENIVASAN.

Practical Invertebrate Anatomy. By W. S. Bullough (Macmillan & Co., Ltd., London), 1950. Pp. 463. Price 28 sh. net.

In this book the author has briefly described the structure of 122 invertebrate animals commonly examined or dissected by students working for their Pass and Honours degrees in Zoology. The book is divided into twenty chapters; each chapter deals with examples of one phylum, although the large phylum Arthropoda rightly occupies five chapters. The descriptions are prefaced by a short account of the characteristics of the phylum and class as well as of the distribution, habitat and mode of life of the genus, and are accurate and of

reasonable length, although a few details are not strictly correct. On page 183, for example, it is stated that "each nephridium (of *Hirudo*) has a nephrostome opening into a coelomic pouch, which in those segments possessing testes is also the testis pouch." It has been definitely proved (*Q.J.M.S.*, 1938) that the initial lobe of the nephridium of *Hirudo* (as of *Hirudinaria*) is always blind and there is no such structure as a nephrostome, forming the inner end of the nephridium comparable with the nephrostome of an earthworm nephridium. What is present is a "ciliated organ" enclosed separately from the nephridium proper within a coelomic space in one of the walls of the testis-pouch and not communicating with the lumen of the testis-pouch itself. Further, in the non-testicular segments, there is not even a separately enclosed "ciliated organ", nor is there a coelomic pouch in connection with the nephridium. But these minor inaccuracies, which will undoubtedly be corrected in a subsequent edition, do not detract from the value of the book over which the author has taken great pains. The book is profusely illustrated with original diagrams drawn from dissections. We commend the book for use in Indian Zoological Laboratories, where it will prove very instructive and helpful.

K. N. B.

Equilibrium Data for Tin Alloys. (Tin Research Institute, Middlesex, England), 1949. Price 2 sh. 6 d. net.

The equilibrium diagrams of binary alloys of various metals with Tin are collected together and presented in an attractive and intelligible fashion in this publication, which also contains a bibliography of ternary diagrams of important alloys of tin.

The diagrams, based upon latest research, are accompanied by adequate explanatory notes on crystal structures and composition limits of various microstructural phases, solid phase transformations, etc. The diagrams of greatest importance are undoubtedly those of Sn-Cu, Sn-Sb, Sn-As and Sn-Ag which are here well supported by general data.

The printing and general get-up of the publication leave little to be desired. While an additional page giving data about tin itself would have been of considerable general interest and value, the publication is a valuable addition to the research metallurgist's library.

E. G. R.

Preface to Library Science. By S. R. Ranganathan. (University of Delhi, Delhi), 1948. Pp. 203. Price Rs. 9.

This book provides a background instruction to students of the library course in the University of Delhi, and is in part addressed to all those who are interested in libraries. No details of the routine library work are to be found in this book, these being left to the regular course work. A good part of the book explains in detail the five laws of library science which were published by the author first in 1931. It is stated that these laws are as simple and "trivial" as the fundamental laws of any other branch of science, and a plea has been put forth for the recognition of the technique involved in library work as a separate science by itself. It is further urged that instruction to students of library science should be imparted at the University level, with short-term and long-term courses ending in certificates and diplomas and graduate and post-graduate degrees.

That there is a technique in librarianship cannot be denied at all, but whether it is of the professional type or of scientific standing needs careful consideration. Librarians, who know the depth and breadth of the technique, will hardly disagree with the author, but it is the uninitiated who are likely to be unappreciative of the claim. One might argue that if systematic botany or zoology is a branch of science, library classification around which library routines have been developed is as scientific in its foundation or structure. The whole question is, however, such as can be authoritatively solved by the world of science.

The third part of the book deals with the author's plea for a library grid for the country, of which a first outline was published in the form of a pamphlet in the "Library in India Series" in 1944. The treatment of this part is rather cursory, but it gives the reader an idea of the magnitude and urgency of the problem. The book, though apparently rather highly priced, is worth reading by all who want to have an overall general picture of the library problem in India.

G. T. KALE.

Ionisation Chambers and Counters. By Bruno Rossi and H. Staub. National Nuclear Energy Series, V-2. (McGraw Hill Book Co., New York), 1949. Pp. 243. Price \$ 2.25.

The spectacular landmarks in the progress of physics in recent years have been usually connected with the development of new experimental techniques of detection and

measurement. The practical realisation of Atomic Energy and the bomb has resulted amongst other things from tremendous advances in nuclear experimental technique and from the importation into physical experimentation of tricks discovered in electronics and radar. Research workers would therefore welcome the publication of the National Nuclear Energy Series embodying reports of experimental work carried out under the U.S.A. Atomic Energy Project, even though these reports cover only declassified work and contain much that is commonly known amongst advanced schools of nuclear physics in Europe and America. The present book is the second volume describing the experimental techniques of the Los Alamos Laboratory and relates particularly to ionisation chambers and counters.

The opening chapter presents without attempting to derive many of the formulæ, the main facts of the behaviour of free electrons and ions in gases which form the basis of the operation of detectors of nuclear particles. Indeed, to a reader who is not familiar with this branch of physics, it would be impossible to appreciate the significance of many cunning devices which are described in detail in the later chapters. While ionisation chambers measuring approximately constant sources of ionisation have been in use for a long time, the main advance in recent years is in the design of fast chambers which, with special associated circuits, reproduce faithfully the shape and size of the original ionisation pulse. The design and construction, the calibration and the theory for interpretation of results of various types of chambers and proportional counters for not only the heavy nuclear particles, but also Beta,

Gamma and X-rays are described with a wealth of practical detail which will be most valuable to research workers in this field. The chapters on neutron and fission detectors are particularly interesting for the ingenuity of design of apparatus. This applies especially to the flat response neutron counter, and to the spiral fission chamber which is described in some detail and which combines very high counting yield with extremely small dimensions. The appendix at the end contains a number of useful results and formulæ for the experimenter.

The subject of geiger counters is not dealt with in great detail, but this is not a serious deficiency as there are already good books dealing with this subject exhaustively. Of interest in this book to any experimenter would be the account of the hot calcium purifier (page 108) for the gas fillings used in chambers, and the technique of drilling in glass plates holes as small as 3 mils in diameter and fusing platinum wire in them (page 199).

The usefulness of this book would be very much increased if it had a complete bibliography. But the authors have in the Preface excused themselves for this omission due to the special circumstances under which the original laboratory reports were compiled and prepared for publication. As it stands, the book will be useful or indeed fully comprehensible only to research workers specialised in experimental nuclear physics. The small band of such workers in this country will certainly profit enormously by acquiring from this book the 'know how' which is otherwise so difficult to obtain.

VIKRAM SARABHAI.

THE GOVT. BOTANIC GARDENS, OOTACAMUND

THE Ooty Botanic Gardens, whose centenary was recently celebrated, owe their inception to the organising genius of Mr. McIvor of the Royal Botanic Gardens at Kew and have, as was emphasised during the celebrations, attained to the position of a national asset both from the points of view of æsthetic education and scientific progress. They have indeed led the way in the development of the cinchona industry, introduction of the potato crop, cultivation of English vegetables and study and nurture of medicinal plants like the eucalyptus.

Botanists and Horticulturists who have visited it will know that it houses plants repre-

senting over a hundred families and drawn from more than thirty countries of the world. Of roses alone, there are nearly 80 species, while of the eucalyptus, there are nearly 35 varieties. Equipped on thoroughly modern lines as an experimental research station, the Gardens have been doing useful work on hybridisation and cultivation of ornamental and economic plants.

With more intelligent support from the Government and the people, there is no reason why the century which it has just begun should not prove even brighter than the one which it has just completed.

N. R. S.

SCIENCE NOTES AND NEWS

Helminthological Society of India

At a meeting of the Helminthological Society of India held in Lucknow on April 8th, the following papers were read: "A Redescription of *Bucephalopsis Karvei* (Bhalerao, 1937) from *Belone cancella*" by Mr. S. P. Gupta; "A New Species of *Asymphylogora*" by Mr. N. N. Srivastava and "The Life-History of *Moniezia expansa*" by Mr. Suresh Singh. The following were elected as Honorary Fellows of the Society: Professor R. T. Lieper, F.R.S., Emeritus Professor of Helminthology, University of London and Professor Emile Brumpt, Professeur de Parasitologie and Director, Institute de Parasitologie, Université de Paris, France.

A resolution moved by Dr. J. Dayal stressing the immediate need of the establishment of a National Research Laboratory for Parasitology was unanimously passed, and the Society also accepted a suggestion made by Dr. S. L. Hora for the preparation of a list of workers and institutions in the country interested in helminthology with a view to ensure greater contact and co-operation among them.

Indo-Pacific Fisheries Council

The Indo-Pacific Fisheries Council held its 2nd Annual Meeting at Cronulla, N.S.W., Australia, from April 17 to 28, 1950. The Meeting was attended by 35 Representatives of 11 of the 14 Member Governments of the Council. Representatives were also present from SCAP, UNESCO, and the South Pacific Commission.

The Council elected Dr. J. D. F. Hardenberg of Indonesia as its Chairman and Dr. D. V. Villadolid of the Philippines as its Vice-Chairman for 1950-51. Technical Committees were appointed and various Ad Hoc Sub-Committees were set up. Mr. W. H. Schuster of Indonesia was appointed Chairman of Technical Committee I, which deals with biology and hydrology, and Mr. G. W. Rayner of Australia was appointed Rapporteur. For Technical Committee II, which deals with technology and economics and statistics, Mr. Claro Martin of the Philippines was appointed Chairman, and Mr. C. G. Setter of Australia was appointed Rapporteur.

The Council received a wide range of technical papers relating to all aspects of its programmes. These papers were received in by the full Council and were also discussed by the Committees. The latter presented reports sub-

mitting various recommendations and resolutions for the work of the Council during the succeeding years.

Technical Committee I has proposed work on the Tunas and also on the neritic-pelagic group of fish; it will carry out work on fish culture and on the transplantation of fish. There will be work on planktology, hydrology and taxonomy. Technical Committee II will continue its programme of surveying the industries of this region.

One of the Council's major projects consists of a Register of the Projects, Institutions, Vessels and Personnel concerned with fisheries work in the Indo-Pacific region. Plans have been made for the completion of this Register and for its publication at the earliest opportunity.

Building Research Congress, 1951

A comprehensive congress on building research is to be held in London from September 11th to 20th, 1951, to review the progress made in research in relation to architecture, building, and the associated branches of civil engineering and will be the first of its kind ever to be held.

The Congress is sponsored by the British professional institutions and learned societies interested in building science, and by government departments, with the support of representative industrial federations in Great Britain. The Department of Scientific and Industrial Research is providing the central organisation for the Conference. Papers are being invited from research workers in many countries on a wide range of topics, and arrangements are being made to welcome to the Congress a large number of visitors from overseas.

The scope of the Congress is indicated by the following representative list of subjects. The papers presented will deal with recent research and its influence on modern development.

The effect of summer and winter conditions on the heating and cooling of buildings; the lighting of buildings; problems of special types of buildings, particularly schools, hospitals and factories; the acoustics of auditoria and broadcasting studios.

Mechanisation of building operations; prefabrication; steelwork design; concrete design; soil mechanics and the design of foundations.

Weathering and durability of building materials in temperate and extreme climates;

lightweight concrete; quality control and accelerated curing of concrete; development in manufacture and the structural use of burnt clay products; stone for housing and developments in quarry mechanisation; gypsum products, limes, painting, etc.

The Congress will be organised in three divisions which will hold concurrent meetings.

Visits to buildings of interest] and to civil engineering works, etc., will be arranged during the period of the Congress.

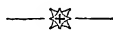
Further information can be had from the Organising Secretary, Building Research Congress, 1951, Building Research Station, Bucknalls Lane, Garston, Watford, Herts, England.

RESEARCH FELLOWSHIP AWARDS

Institution	Recipient	To work on	At
NIS Senior Research Fellowships	Mr. S. P. Bisu, M.Sc. (Cal.)	Some physico-chemical factors affecting fresh-water fish cultural practices	All-India Institute of Hygiene and Public Health, Calcutta
	Dr. Sakh Dev, Ph.D. (Punjab)	Studies in Sesquiterpenes	Indian Institute of Science, Bangalore
	Dr. P. B. Mathur, D.Sc. (BHU)	Preventive measures to eliminate the loss of vitamin C during storage in potato tubers	Agricultural College, Benares Hindu University
	Mr. V. R. Thiruvengatchar, M.Sc. (Mys.)	Compressible Fluid Flow	Central College, Bangalore
NIS Junior Research Fellowships	Mr. V. Chandrasekharan, M.Sc. (Mys.)	The scattering of light in crystals and determination of elastic constants	Indian Institute of Science, Bangalore
	Mr. A. K. Chaudhuri, M.Sc. (Cal.)	Electron Optics of the electron gun used in Electron Microscopy.	Calcutta University
	Dr. G. S. Deshmukh, D.Sc. (BHU)	Analytical Aspects of Cerium and Thorium Chemistry	Benares Hindu University
	Dr. B. D. Mundkur, Ph.D. (Wash.)	Heredity and Variation in Ascomycetes, particularly anti-biotic yielding Fungi	Bombay University
	Mr. N. Satapati, M.Sc. (Andhra)	Petrology, Petro-chemistry and Petrotectonics of Eastern Ghats	Andhra University
	Dr. G. Venkatachalam, Ph.D. (East Lansing)	Animal Breeding including Animal Genetics and Applied Statistics	Livestock Research Station, Hosur
	Dr. (Mrs.) Vidyavati, Ph.D. (Luck.)	Problems in the Anatomy of <i>Labco Rohita</i>	University of Delhi
Imperial Chemical Industries (India) Research Fellowships	Mr. C. Balakrishnan, M.A., B.Sc. (Mad.)	Study of Internal Conversion Coefficients of radio-isotopes	National Physical Laboratory, New Delhi
	Dr. I. M. Chak, Ph.D. (Bom.)	Preparation of Haemostatics from oil-seeds	Indian Institute of Science, Bangalore
	Mr. A. G. K. Menon, M.A. (Mad.)	Ichthyological studies with special reference to Zoogeography	Zoological Survey of India, Calcutta
	Dr. G. C. Mitra, D.Phil. (Cal.)	Morphogenetic studies: The origin and development of the leaves and their parts at the shoot apices of Angiosperms	Calcutta University

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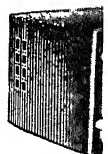
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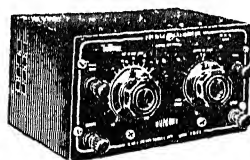
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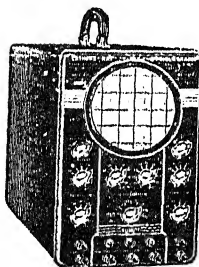


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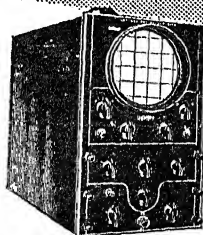


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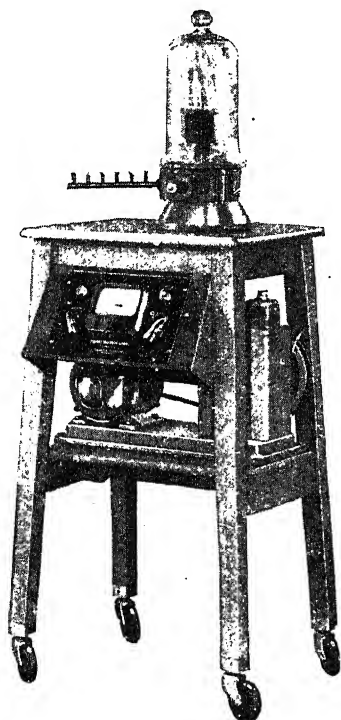
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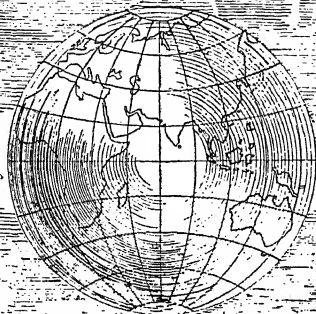
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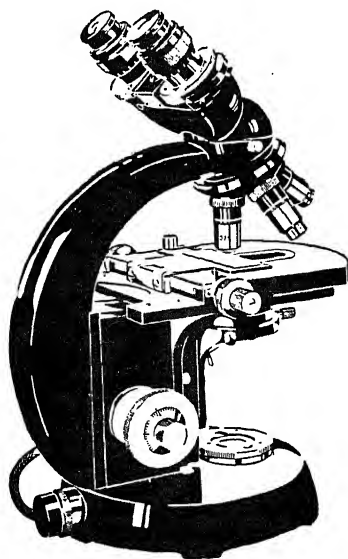
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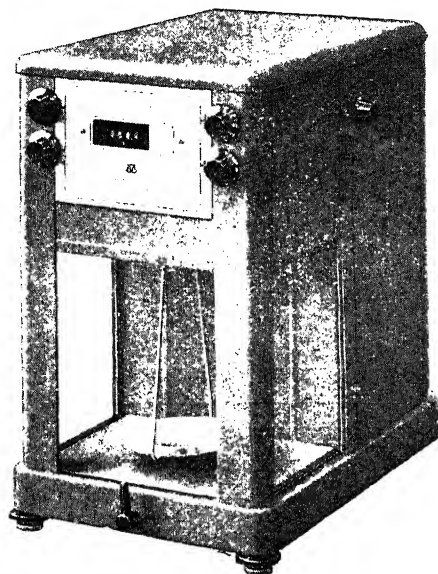
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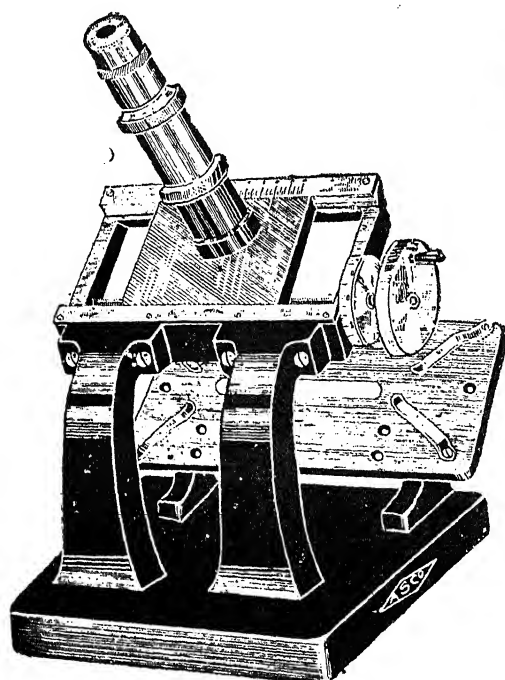
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Current Science

Vol. XIX]

JULY 1950

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THE INDUSTRIAL APPLICATIONS OF ATOMIC ENERGY*

THE picture of the production of atomic energy for industrial purposes which we can envisage at the moment is not encouraging. The fast neutron reactors require rather concentrated fissile material as atomic fuel, and this is very difficult and expensive to produce. The slow neutron reactors utilize only a very small fraction of the rarer isotope of uranium and produce about the same quantity of plutonium. Much more than this must be achieved if atomic energy is to compete successfully with coal as a source of power. Fortunately, the way out is clear, though it has not yet been achieved in practice, and the solution brings with it the possibility of using thorium as well as uranium, as a nuclear fuel.

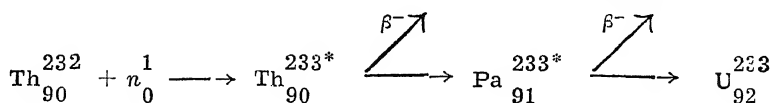
"BREEDER" REACTORS

On the average a fission process releases several neutrons, say three. If it is assumed

that there are in the reactor no impurities or materials of construction other than uranium which absorb neutrons, the three fission neutrons can be utilized in the following way: At constant power output, one of these neutrons must produce a fresh fission by absorption into the nucleus of another fissile atom. A second neutron can be captured by uranium of mass 238 to produce an atom of plutonium, thus replacing the atom of fuel which has been used. The third neutron can be absorbed by a second U238 atom giving another plutonium atom. Thus a reactor operating in this way should produce more nuclear fuel than is burnt and is called a "breeding" reactor. The breeding process should make it possible to utilize the whole of the uranium, the plentiful U238 as well as the scarce U235. If the excess neutrons are absorbed in thorium instead of U238, a new fissile material which can replace U235 or plutonium is produced by a process very similar to that which produces plutonium. We

* Abstracted from the 1950 Trueman Wood Lecture, by Prof. M. L. Oliphant, F.R.S.

can represent this process by the nuclear equation



The thorium nucleus absorbs a neutron producing a radioactive isotope of thorium of mass 233. This emits a negative electron or β -particle, transforming into a radioactive form of proto-actinium, which emits a further β -particle to give an isotope of uranium of mass 233. U²³³ is a fissile substance which can be used as a fuel in a nuclear reactor. Thus, in time, it should be possible to change over from uranium to the more plentiful thorium as fuel for the production of nuclear power.

The design of a successful breeding reactor depends upon the elimination from the reactor of materials which capture an appreciable fraction of the neutrons without contributing to the production of power or of fresh fissile material. There are reasons why this may prove to be more practicable with the fast neutron reactors than with those using slow neutrons, partly because the smaller mass of fissile material in the reactor can be prepared in a state of higher purity, partly because there is no moderator, but principally because the essential materials of mechanical construction and the cooling fluid which can be used in a fast neutron reactor are not so restricted in properties. The most important of the factors to which answers have yet to be found is the extent to which the materials in the reactor retain their physical properties of strength, etc., when the atoms of which they consist are continually stirred up and knocked out of place by collisions with fast neutrons.

EXPERIMENTAL PROGRAMME IN U.S.A.

The Atomic Energy Commission in the U.S.A. has announced the construction of two types of experimental breeding reactor and a materials-testing reactor. The first of these is designed to test the practical feasibility of breeding with fast neutrons and to investigate the application of liquid metals to the removal of fission-produced heat at high temperatures. The second will produce significant amounts of electric power from a reactor using neutrons in the intermediate range of energies, and at the same time determine whether breeding is possible under these conditions. The heat will be removed with liquid metal and power will be generated from this by conventional means. These breeder reactors, together with the

materials-testing reactor, are estimated to cost about 70 million dollars.

ECONOMIC COST OF NUCLEAR POWER

It is not easy to estimate as yet the economic cost of nuclear power. The energy derived from 1 lb. of uranium, completely utilized in a breeder reactor, is equivalent to that produced by burning 1,500 tons of coal. The cost of uranium is about 1,000 times the cost of coal. This leaves a factor of about 3,000 to cover the cost of converting the uranium to a form suitable for use in a reactor and the greater cost of nuclear reactor over a coal furnace. In the absence of precise data it is possible only to guess the ultimate answer. Nevertheless, I venture to think that the cost will ultimately be found to be competitive with, and probably much less than, the cost of power from other sources. The time required to reach this stage of development is not likely to be less than 10 to 15 years and clearly depends on the relative efforts devoted to the military and industrial objectives. Uranium is more widespread in occurrence than was thought to be the case and, with the development of methods for extracting it from low-grade ores, there should be sufficient available to provide a great contribution to the power resources of the world if it is not used for the manufacture of military weapons.

HYDROGEN AS A NUCLEAR FUEL

Finally, we must consider the possibility that industrial power may one day be produced from hydrogen. Long before the discovery of the fission process it was realized that under conditions of extremely high temperature and pressure, such as exist in the interior of sun and stars, hydrogen nuclei, or protons, might combine together to give nuclei of heavier elements and that because the component parts of heavier nuclei are very tightly bound together, sufficient energy would be released to maintain the temperature of the star. If it were possible to find a method by which heavier atoms could be synthesized from hydrogen at will and under controlled conditions, very large amounts of energy would be available. Thus, if four atoms of hydrogen condense to form an atom of helium, the energy set free is about five million times as great as that produced when an atom of carbon is burnt. In other words, 1 lb. of hydrogen transformed into helium would produce about 100 million kilowatt-hours

of heat energy, or about 130 million horsepower for an hour. Thus hydrogen as nuclear fuel would be about 10 times as good, weight for weight, as uranium. There are possible ways in which an explosive reaction of this type can be produced by utilizing the very high temperature and pressure developed in the explosion of atomic bomb, but so far there is no clue to a method for bringing about the reaction in a controllable way. However, it is interesting to speculate on the possibility that nuclear scientists may discover how to do this in the future.

There is enough hydrogen in the sea, if it were all converted into helium, to raise the temperature of the whole earth to at least one million degrees centigrade, i.e., over hundred times the temperature of the surface of the sun. Fortunately for us the possibility of bringing about such an explosion can be ruled out, if for no other reason than that if it were possible, it would have happened in the past history of the earth. However, if we accept

as the desirable power level for civilization that every individual should utilize, on the average, 1 kilowatt of power continuously, we can calculate that 3,000 million inhabitants of the earth could be supplied with power from the hydrogen of the sea for 1,000 million, million years, or for about a million times the age of the earth itself. Thus, if this remote possibility is realized, mankind would have no need to look elsewhere than to the sea for all the power they can conceivably use in the lifetime of the solar system.

In conclusion, it must be emphasised that industrial power from uranium is on the doorstep and will almost certainly be used successfully, while power from hydrogen is only a remote possibility in the light of existing knowledge. In any case, the probability is small that any nuclear power will be available for useful purposes unless the problems of war can be solved, and that is a question for all mankind and not for the scientist alone to solve.

ROCKEFELLER DONATION TO THE M.I.T.*

THE Massachusetts Institute of Technology recently announced the receipt of a gift of \$ 1,000,000 from John D. Rockefeller Jr. to be used for "buttressing of the Institute's financial stability and independence as a private institution".

The gift was announced by Marshall B. Dalton, Chairman of the Institute's Development Program, at a meeting of more than 200 alumni members of the National Committee on Financing Development. The Committee was established in 1948 to "fund M.I.T.'s independence" through a \$ 20,000,000 development program. Mr. Dalton said that Mr. Rockefeller's gift increased to \$ 12,162,309 the total raised to date.

Mr. Rockefeller wrote to Dr. James R. Killian Jr., President of the Institute, that "because of the Institute's outstanding position of leadership in the field of science, the high order of service rendered by it, as well as the promise of future achievement which it gives, I am glad to have a part in the effort to broaden its educational program and strengthen its financial condition."

He expressed the hope that the Institute would continue to expand its "strategic service" to all interested in the advancement of science.

* With acknowledgments to *World in Brief* News Service.

INTERNATIONAL CONFERENCE ON ATOMIC ENERGY

TWO hundred nuclear experts representing most of the Western nations and the Commonwealth countries are expected to attend the first big international conference on atomic energy to be held in Britain in September.

The conference is being organised by the British Atomic Energy Research Establishment. Most of the meetings will take place at Oxford

University and the conference will last one week.

Discussions will be divided into two parts. The first section will be mainly concerned with the use of high energy accelerators for experiments in nuclear physics. The second part will deal with work at lower energy levels and include discussions on the employment of atomic piles for research and experiments.

THE PROBLEM OF THE CRETACEOUS-EOCENE BOUNDARY

L. RAMA RAO

(Central College, Bangalore)

OF all the 'Boundary Problems' in stratigraphy, the Cretaceous-Eocene boundary is the most interesting, and has been the subject of considerable study and discussion in many parts of the world. In all such studies, the usual tendency is to try to equate all correlations with those of the European stratigraphical scale and adopt the same terminology in describing the succession in the several places. While it is no doubt useful for us to have clear and definite ideas regarding the Cretaceous-Eocene transition in Europe in tackling similar problems in other countries, we must at the same time realise the inherent limitations in the process of long distance correlations and the danger in too readily importing 'European' ideas and seek to establish identity of chronological equivalence in widely separated parts of the earth.

It is obvious that the most favourable areas for the study of the Cretaceous-Eocene boundary are those places where we seem to have a continuous succession of marine fossiliferous sediments including the uppermost Cretaceous and the lowermost Eocene; if, in any area, this succession is not wholly marine but is interrupted by the occurrence of fresh water and fluviatile beds in between, conclusions regarding the boundary naturally become doubtful and controversial.

In many parts of the world the dividing line between the Cretaceous and the Eocene is clearly indicated by a stratigraphical and/or palaeontological break in the succession revealing an unconformity or disconformity, and there is no difficulty here in defining where the one system ends and the other begins. There are a few places, however, as for instance in parts of western Europe, where no such break is recognisable; and it is these areas, though very small in extent, that are of particular interest in the study of the Cretaceous-Eocene boundary, and as such deserve special attention.

The position regarding this part of the succession in the European stratigraphical scale is indicated in Fig. 1. There is no doubt that the strata right up to and including the Maastrichtian belong to the Cretaceous; it is equally certain that the beds from the Thanetian upwards form part of the Eocene. Between these two subdivisions—the Maastrichtian and the Thanetian—we have a series of beds in different places whose exact position

in the scale is uncertain and controversial and these are the beds which cover the Cretaceous-Eocene transition period. Such transition beds are found in parts of western Europe including N. France, Belgium and Denmark; and even there, they occur in a number of

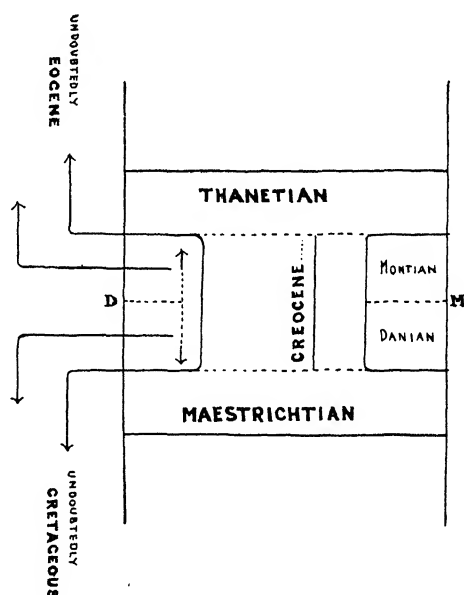


FIG. 1

The Cretaceous-Eocene Transition

small isolated patches with rapidly varying lithological and ecological facies. There is thus much difficulty in defining their classification and assigning the component beds as between the Cretaceous and Eocene. While a broad grouping of these beds into two divisions, the Danian and the Montian, is generally accepted, opinion regarding the relationships of each of these with the Cretaceous on the one hand and the Eocene on the other, have been varying. At one time it was thought that both the Montian and the Danian belonged to the Cretaceous; later, others believed that both of them formed part of the Eocene. Some others classified the Danian as the youngest Cretaceous unit including the Maastrichtian and the Montian as its lower and upper subdivisions.

In accordance with the generally accepted scheme, the Maastrichtian-Thanetian interval is shown in Fig. 1 as composed of the two divisions Danian and Montian, the dividing

line D M being drawn diagrammatically right in the middle and considered as demarcating the boundary between the Cretaceous and Eocene. But, actually, the position is not so simple. If we make a comparative study of different areas in and outside Europe, this significant line seems to shift upwards and downwards in the scale depending upon the local oscillations of sea level and varying with the particular basis, stratigraphical and/or palæontological, on which we proceed to consider the question in each case. In some cases, the line shifts towards the Cretaceous side, thus reducing in degrees varying from place to place, the scope and importance of the Danian; while in others, the shift is towards the Eocene side, thus enlarging the Danian and correspondingly reducing the prominence of the Montian. The only satisfactory way to decide upon a boundary line in any area where we have such transition beds is to take a collective and comprehensive view of the stratigraphical and palæontological evidences in that region with due regard to their previous and subsequent trends of development, and come to an agreement by a convention as to where to draw the boundary; for let us remember that where we have a really complete and continuous record of past changes, it is impossible to draw a hard and fast divisional line between the two systems which would hold good from all points of view, for the simple reason that such a line does not exist in nature.

The most important point to note is that any such boundary line which we may agree to draw between the Cretaceous and the Eocene upon the evidence in any particular area can hold good only for that region; it would be a great mistake to import those ideas to other parts of the world and seek to establish equivalence or non-equivalence of strata on the basis of one or two random criteria and thus try to solve the problem of the Cretaceous-Eocene boundary in these different places. On the other hand, the position in each region is to be judged on its own merits. While the general principles that must guide us are no doubt the same in all cases, the actual study of the transition and the drawing of a boundary line in any particular area must be decided on the evidences revealed in the localities concerned. It is particularly important for us to remember this point, for here, in India, we have

a most interesting field for the study of the Cretaceous-Eocene boundary* awaiting proper investigation. The free and indefinite use of the terms 'Danian' and 'Montian', and the uncritical manner in which names of fossils like *Nautilus danicus* and *Cardita beaumonti* have been used as age fixers, have largely added to our confusion and trouble in studying this problem here.

It is obvious that the Cretaceous-Eocene boundary lies somewhere in the Mæstrichtian-Thauetian interval; and all the beds falling in this part of the stratigraphical succession in any part of the world will constitute the 'passage' from the Cretaceous to the Eocene in that area. As such passage beds are usually of shallow water origin occurring in small, scattered, and localised patches, and showing variations in the facies of deposition, the mutual correlation of their transitional stages are not easy to decipher in widely separated areas. In the present state of our knowledge, it is best that all such 'passage beds' in any particular area are clubbed together as a composite group to which the term CREOCENE may be applied. The actual level in this assemblage where we agree to draw the boundary line between the Cretaceous and the Eocene in any given area has to be decided on the basis of the available stratigraphical and palæontological criteria in that particular area, without for a moment imagining that such a line should be of universal applicability and be constant in its relative stratigraphical position throughout the world. From the point of view of world stratigraphy, the recognition of the 'Creocene' beds in any place is the really important point; for it means that here we have a succession representing the passage (wholly or partly) from the one system to the other and hence worthy of detailed investigation as contributing to complete our picture of the geological history during the Cretaceous-Eocene transition period; where exactly we agree to draw the boundary line between the two systems in the 'Creocene' succession of any given area is a local matter and is of no great consequence from the larger point of view of Earth History as a whole.

* L. Rama Rao, Presidential Address to the Geology Section of the Indian Science Congress, 1940.

THE POWER ALCOHOL INDUSTRY IN INDIA

Y. K. RAGHUNATHA RAO

(Bangalore)

THE production of power alcohol, for blending with petrol as a motor fuel has not made much headway in the last five years, despite the Governmental pronouncement and encouragement to sugar-factory owners. The output was less than a million gallons in 1945, and had not reached 5 million gallons three years later, whereas the target is over 20 million gallons a year. There are about twelve Absolute Alcohol Plants in service (9 in U.P.). Five more are expected to work and raise the output to 5 million gallons shortly. There is, however, little chance of many more units being put up by private owners. It is left to the Governments, Central and Provincial, to provide incentives to private enterprise or to set up plants themselves.

The lack of incentive to the private owners has been due to the advent of prohibition; large profits to distillers have vanished with the liquor trade. The U.P. Government, therefore, allows a portion of the product to be sold as rectified spirits for several industrial uses at a higher price than for absolute alcohol, bought by the State for blending with petrol. But to most sugar-factory owners, who have set up distilleries, the margin of profit is not adequate. They would desire it to be raised. The capitalist is not fully aware that though a higher price brings him more profits, an increased efficiency of production pays better and is a permanent advantage to all alike. At the moment, there is not much likelihood of the desirable change being made except at the instance of the Government. It lies within the province of the recently appointed Planning Commission to ensure the expansion of the industry by setting up model distilleries, training operative staff, devising means to solve urgent technical problems and to carry out research on related Fermentation Industries and thereby modernise the industry in the light of advances made in distillery practice.

A few technical problems, contributing to the high cost of production might be mentioned here; e.g., the disproportionate outlay on buildings, in some distilleries: indifferent design and construction of some plants: inadequate equipment for proper fermentation: absence of qualified technical staff and sometimes lack of appreciation by the management of the necessity for industrial research on the spot, or to take note of recent advances in the industry and to adapt them to local conditions,

For example, a problem often met with in some distilleries is the scaling of the stills, involving discontinuous operation. The molasses sometimes have high mineral content, 12 to 13 per cent., due to the nature of sugarcane or faulty liming in the factory. In such cases, clarification of molasses is indicated.^{1,7}

In October 1944, the Council of Scientific and Industrial Research sponsored a research project for increasing the concentration of distillery washes from the 6-7 per cent. obtaining in Indian distilleries, to 12-14 per cent. The project has culminated in the development of a patented process² which seeks to eliminate the problem of scaling, effect a saving in fermentation capacity, increase the overall efficiency and reduce costs of production.

The process is not a laboratory scale curiosity; it is reported to have been successfully demonstrated on a factory scale in a couple of distilleries in Northern India.

TABLE I

Fermenter No.	1	2	3	4	5	6
Wash—Sp. Gr.						
Initial	1096	1096	1129	1129	1142	1150
Final	1032	1034	1050	1042	1047	1047
Attenuation	64	62	79	77	95	103
Alcohol % Vol.	9.35	9.0	10.85	10.3	12.74	13.3
Acids %	0.60	0.63	0.72	0.65	0.66	0.60
Unfermentable sugars %	1.10	1.13	2.14	2.90	1.76	1.80
Conversion of						
Initial Sugar	100	..	..	..	100	100
To Alcohol	83.58	..	..	..	84.87	82.5
To Acids	5.52	..	..	..	4.2	3.6
To other products	3.90	..	..	..	3.49	6.83
Unfermentable Sugars	6.84	..	..	..	7.43	7.00

It has now been possible to obtain 9 to 12 per cent. alcohol in distillery wash.³ In this process, selected yeast is grown under controlled conditions⁴ and developed in molasses wash and the final fermentation completed in 12,000 gallon steel fermenters. A partial adoption of the new process resulted in increasing output of a North Indian distillery⁵ from 1,800 gallons daily to a maximum of 3,450 gallons of alcohol *without appreciable alteration in plant*. The steam consumption is reduced by 10 lbs. per gallon of alcohol produced, and other benefits having resulted, *the cost of production goes down by a third of the original*.

The appended Table I⁶ shows data relating to the conditions of fermentation, attenuation obtained, and alcohol per cent. in the wash. Generally from 12 to 13 per cent. alcohol is obtainable with a conversion of 82 to 85 per cent. of the sugars in molasses to alcohol. These figures show that a high degree of efficiency is obtainable. By adoption of the new technique in all distilleries, I anticipate that the output could be doubled quickly to over 6 million gallons annually in India. It is, of course, necessary to use modern methods of fermentation control and obtain adequate technical advice to adapt the plant and equipment in existing distilleries, which are not all efficient ones.

The nature of molasses has much to do with fermentation; as North Indian molasses contain more minerals and sometimes bacterial contaminations, the process has to be adapted to suit the local conditions.

For expansion of output, the necessary measure is to instal many more small-sized plants, made locally but modern in design and workmanship. A 2,500 gallon unit made by the author is in service at Simbhaoli (U.P.). Smaller units could well be put up at suitable sugar factories, thereby avoiding expense on transport of molasses.

Production of Power Alcohol, a key industry whose importance has increased beyond expect-

tation ever since its use in the propulsion of rockets, could be stepped up either by the Government conceding a higher price to producers after inspection of the plants and insisting on the adoption of modern improvements to raise the efficiency, or by the State setting up a model full-fledged distillation units incorporating the latest improvements in technique and processing with the object of demonstration to the conservative factory-owners.

It is clear that there is a need immediately to set up requisite organisation for the establishment of the industry on a sound basis, for collection of data, study of its problems and of related industries.

With the implementation of such ideas in practice and with the co-operation of the present distilleries and sugar factories, the target of an annual production of 20 million gallons of power alcohol may be reached in less than five years, solving partially, the country's fuel needs.

-
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SCIENCE IN PAKISTAN

IN the course of his inaugural address at the All-Pakistan Science Conference held at Sind University, Karachi, the Governor-General H. E. Khawaja Nazimuddin very rightly pointed out, "If we are to build our State on progressive lines and bring about a radical change in the living conditions of our people, we shall have to make them scientific minded and harness the resources of science for the solution of the problem facing the country." He further said: "The Government of Pakistan envisaged an expenditure of 300 crores of rupees on various nation-building activities during the next ten years. In that great and worthy task of development, science and scientists must play their full part."

The Conference was held under the auspices of the Pakistan Association for the Advancement of Science which was founded soon after the establishment of Pakistan. Among the achievements made by the Association during its short existence of two years, mention may

be made of the publication of the Journals—*The Pakistan Journal of Science* and the *Pakistan Journal of Scientific Research*, which are the first scientific journals to be published in Pakistan.

The First Pakistan Science Conference organised by the Association last year, was a notable step towards the development of Science and Technology in the country. Apart from papers dealing with scientific research, which were read at the Conference, symposia were held on a number of subjects of national importance, among which were agriculture and forest wealth of Pakistan and possibilities of development; future of industrial development in Pakistan; the problem of waterlogging; scientific education. The main achievement of the Conference was to bring together scientists from different regions and from different institutions to discuss the vital problems and focus public attention on them.

(—By courtesy of *Science and Engineering*.)

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RAMAN SPECTRUM OF CRYSTALLINE
BARIUM CHLORATE

BARIUM chlorate crystallises in the monoclinic prismatic class with one molecule of water of crystallisation. A complete X-ray analysis of its crystal structure has not been made hitherto. Its Raman spectrum was first studied by Krishnamurthi¹ (1930) and later by Venkateswaran² (1938). Both of them reported the existence of only four Raman lines with frequency shifts 492, 612, 913 and 929 cm.⁻¹ Using the λ 2536.5 excitation the author has recorded the Raman spectrum of barium chlorate [Ba (ClO₃)₂ · H₂O] in the form of a single crystal.

The recorded spectrum exhibits nineteen Raman lines with frequency shifts 54, 71, 87, 103, 123, 132, 156, 161, 196, 207, 487, 498, 612, 917, 933, 964, 986, 3513 and 3582 cm.⁻¹ They

could be classified under three heads: the first ten coming under the lattice spectrum, the next seven being due to the internal oscillations of the chlorate ion, and the remaining two being water bands.

As is well known, the chlorate ion in the free state possesses four fundamental frequencies, namely, 478 (2), 615 (1), 930 (1) and 975 (2) cm.⁻¹ The figures in brackets represent the degeneracies. It is seen that in the spectrum of crystalline barium chlorate, the degeneracies of lines 478 and 975 cm.⁻¹ have been removed and consequently one observes all the six oscillations due to the chlorate ion with frequency shifts 487, 498, 612, 933, 964 and 986 cm.⁻¹ It is interesting to point out that the sum of the frequency shifts of the first two lines is equal to that of the last line. The additional line appearing with frequency shift

917 cm^{-1} can only be accounted for as due to a doubling of the principal chlorate ion frequency (930 cm^{-1}) which may probably be due to the multiplicity of ionic groups in the unit cell.

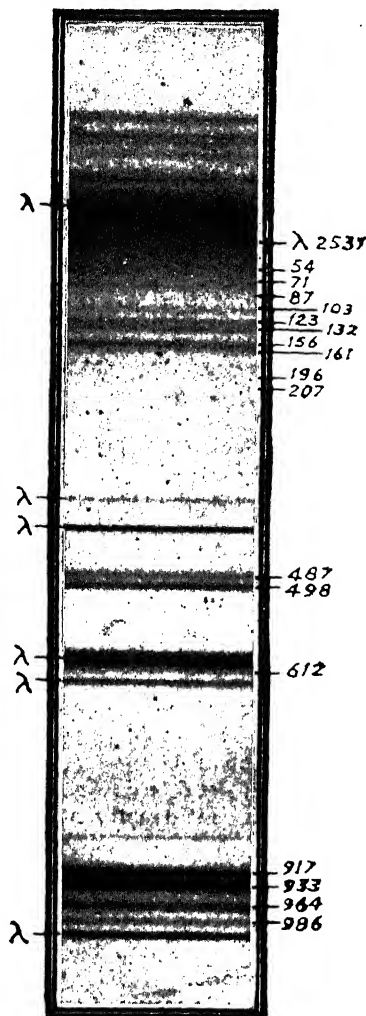


FIG. 1. The Raman spectrum of barium chlorate taken with a medium quartz spectrograph with an exposure of 16 hours. The region of water bands is not shown in this photograph.

The lattice spectrum of barium chlorate exhibits ten frequency shifts whereas that of potassium chlorate³ which belongs to the same crystal class shows only five lines. Unlike many crystals which possess water of crystallisation, in the case of barium chlorate monohydrate, the O-H frequency appears as a very sharp line with a frequency shift of 3513 cm^{-1} . This

is accompanied by a weak companion on the longer wave-length side, i.e., 3582 cm^{-1} .

The author is grateful to Professor R. S. Krishnan for his kind encouragement.

Physics Department, C. SHANTA KUMARI,
Indian Institute of Science,
Bangalore.

June 19, 1950.

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A NEW METHOD OF MEASURING THE ELASTIC CONSTANTS OF SOLIDS

In a note with the same title which appeared in the May issue of *Current Science*,¹ a new method of measuring the elastic constants of crystals of considerable size has been described. It consists in the use of a piezoquartz piece attached to the substance under investigation and the variation of ultrasonic energy transmitted through the substance with the frequency is studied over the entire resonance breadth of the piezoquartz. As the thickness of the specimen used is more than 1 cm., its fundamental frequency will be of the order of .1 to .2 Mc. Since the resonance breadth of the piezoquartz covers a fairly wide region, the ultrasonic energy transmitted through the experimental substance will exhibit a series of maxima when the frequency of the oscillator is continuously varied and it can easily be detected by using the familiar Debye-Sears and Lucas-Biquard arrangement. Each of these transmission maxima corresponds to the excitation of one of the harmonics of the longitudinal vibrations of the crystal block, and hence the difference in frequency between any two successive maxima will be equal to the longitudinal fundamental of the crystal plate. Knowing the longitudinal fundamental frequency, the thickness of the plate and the density of the substance, the effective elastic constant in the particular direction can be calculated. When this method was used to determine the elastic constants of some optical glasses, certain difficulties were experienced—which are enumerated below.

The optical glasses were in the form of rectangular blocks (3 cm. \times 3 cm. \times 2 cm.) and the thickness of these specimens did not vary by more than .003 cm. from 2 cm. The piezoquartz piece used was an X-cut crystal (20 \times 20 \times 1.5 mm.) purchased from Bernhard Halle, Berlin (the orientation of the crystal was also

checked by the X-ray diffraction method). Using the arrangement described above, it was found that over and above the true maxima, many spurious maxima were also observed, the intensities of the latter being practically of the same order as the true ones, thus making it impossible to distinguish the one from the other. It is well known^{2,3} that due to the coupling with overtones of various l.f. modes the frequency spectrum of an X-cut plate in thickness vibration becomes extremely complicated. In other words, the intensity of the impinging ultrasonic energy, instead of increasing smoothly up to the resonance point and then falling down smoothly will have plenty of 'kinks'. Hence it is natural to expect that these extra kinks will also be reproduced in the energy transmitted by the experimental piece and hence recorded as well. These spurious maxima can in a way be eliminated by using a Straubel⁴ X-cut plate, since a plate of this shape is somewhat freer from these multiple frequencies than rectangular or round plates. Using Straubel X-cut plate of thickness 1.00 mm. the results obtained are given in the following table. The corresponding values obtained by the Hiedemann's method^{5,6} are also given for comparison. The procedure adopted in numbering the glasses is the same as in the earlier communication.⁶ It is seen that the agreement is satisfactory.

Glass No.	$C_{11} \times 10^{-11}$ dynes/cm. ²	
	by the new method	by Hiedemann's method
1	5.299	5.530
2	6.707	6.684
3	7.260	7.904
4	7.840	8.078
5	8.468	8.734
6	6.430	6.485
7	7.023	7.238
8	6.516	6.648
9	8.708	9.085
10	6.771	6.890
11	10.201	10.078
12	6.582	6.694
13	7.406	7.680
14	6.240	6.647
15	7.758	7.867
16	6.221	6.637
17	6.176	6.563
18	7.208	7.268

With an X-cut plate, the transverse vibrations do not come up prominently. But when a Y-cut plate is used instead, the same difficulties are again experienced and hence the constant C_{12} could not be measured.

The author wishes to express his grateful thanks to Professor R. S. Krishnan for his kind interest and constant encouragement.

Physics Department,
Indian Institute of Science,
Bangalore,
June 27, 1950.

K. VEDAM.

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A NOTE ON JOSHI EFFECT

In the course of a discussion with Mr. Arnikaar of the Benares University, it emerged that an explanation of both the positive and negative 'Joshi Effect' and the other associated phenomena can be made on the basis of a standard picture of gas amplification given in textbooks;^{1,2} by assuming that by some mechanism low energy visible light can produce additional ionization in the diode. Somewhat similar explanations have been advanced by Salzwedel³ and Fuchs,⁴ but the discussion can be summarised in terms of the following two arguments based on d-c operation.

(a) The major portion of gas amplification takes place near the anode.

This is evident from the well-known equation for electron current density J_e obtained from a gas-filled tube:

$$J_e = J_0 e^{\alpha d}$$

where J_0 is the current density at the cathode face ($d = 0$) and α is the number of ionizing collisions per centimetre of an electron's advance in the direction of the field.

(b) A strong ion sheath is created near the cathode which decreases potential gradient in the region of the anode.

If gas amplification is assumed to be 100, then $J_e = 100 J_0$. However, just near the cathode electron current density is J_0 , and hence, according to the principle of conservation of total current, the positive ion current density near the cathode should be $J_i = 99 J_0$. But since $J_e = \rho_e E g_e$ and $J_i = \rho_i E g_i$, where ρ_e and ρ_i are electron and ion space charge densities, E is the electric field, and g_e and g_i are electron and ion mobilities, and since $g_e \gg g_i$, then $\rho_i E$ near the cathode is much larger than $\rho_e E$ near the anode. Obviously, if by intense illumination ionization is further increased then a denser ion sheath near the cathode will alter the field distribution in the tube (see figure) in such a way that the poten-

tial gradient near the anode, and hence the gas amplification, will be decreased.

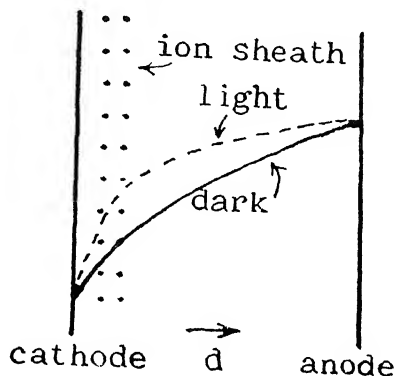


FIG. 1. Electric field distribution in light and dark

The analysis remains substantially the same for change of total current with light under a-c operation. The rate of rise or fall of current, the variation of ' Δi ' of 'Joshi Effect' with intensity of light, and the appearance and suppression of high frequency pulses with light (for a-c) can be satisfactorily explained on this basis.

Physics Department,
Aligarh University,
April 19, 1950.

RAIS AHMED.
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A NEW GENUS OF CALCAREOUS ALGA (DASYCLADACEAE) FROM THE RANIKOT BEDS (PALAEOCENE) OF THE PUNJAB SALT RANGE*

CALCAREOUS algæ both Dasycladaceæ and Corallinaceæ have been recorded from the Ranikot beds. Morellet¹ described several species of Dasycladaceæ from the Ranikot beds of Tibet; Walton² described *Bræckella*³ [= *Triploporella ranikotensis* (Walton) from the Ranikot beds of Sind. Corallinaceæ from the Lockhart limestone of the Samana Range have been described by Rao.⁴ The present record is from the Ranikot beds of Nammal Gorge of the Salt Range and it represents a genus of Dasycladaceæ hitherto not described.

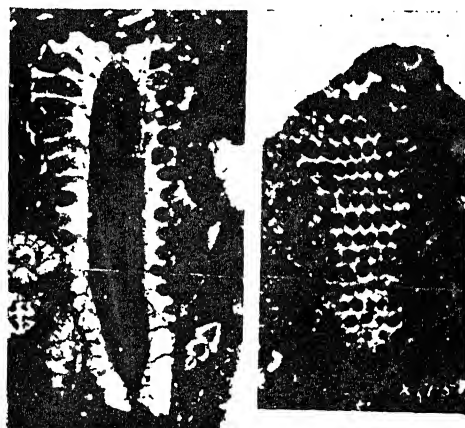
The material containing this new alga named

Morelletpora nammalensis gen. et. sp. nov. was collected by Professor S. R. N. Rao in 1946, from Khairabad Limestone beds (32° 40' : 71° 48') crowded with foraminiferal tests mainly of *Miscellanea miscella*. The diagnostic characters of this genus are based on the study of numerous thin sections and serial preparations.

The diagnostic characters of the genus are:

Thallus club-shaped, upper end rounded with a central depression occasionally open. Axial tube hollow, circular in section, bearing a number of branches of the first order only arranged in verticils forming the cortex. Branches arising as thin, upwardly inclined tubes, enlarging abruptly to form long oval to barrel-shaped sporangia, giving the thinner part a stalk-like nature.

Description—Thallus club-shaped (Fig. 1) upto 4.5 mm. long, round in section, upper end rounded 2 mm. wide with a depression, open in centre. Lower end also open, 0.7 mm. wide surface smooth with no definite pattern. Axial tube 0.2-0.8 mm. wide, longitudinally extending from base to tip. Branches arising in whorls, 0.1-0.2 mm. apart, each with 14-24 stalked sporangia. Stalks of adjacent whorls alternately arranged but the sporangia showing an arrangement neither strictly alternate nor strictly rowed (Fig. 2). Sporangial stalks



Morelletpora nammalensis Varma

FIG 1. Nearly longitudinal section $\times 17.5$.

FIG 2. Tangential section showing the cortical layer.

$\times 17.5$.

0.02 mm. wide, 0.1-0.2 mm. separated from the next in its whorl. Each stalk enlarging in a sporangium oval or barrel-shaped, 0.1-0.2 mm. wide and 0.2-0.3 mm long. Stalks in lower whorls longer, arising at angles between 50-70°; those in upper whorls, arising

at about 45° (range $35-50^\circ$) ending in single sporangia on relatively short stalks.

Comparisons—The genus is readily distinguished from forms possessing secondary and tertiary branches by the fact that it is characterised by first order branches only. *Bræckella ranikotensis* (Walton) shows some similarity with it in external form of the thallus but differs, besides other minor details, in not possessing anything of the type of a stalk observed in the latter. Moreover, the former possesses secondary branches which are not present in the new genus.

Among forms possessing only the primary branches, the present genus shows some similarities with the genera *Gyroporella* and *Uragiella*. *Gyroporella vesiculifera*³ Gûmb. and *Uragiella suprajurassica*³ Gûmb. approach it in showing a tendency to form stalked sporangia. The former differs from the present one in having a cylindrical thallus, spherical sporangia and the stalks arising at right angles to the axis, along with many other minor details. The latter form differs in having a cylindrical thallus with club-shaped obliquely and upwardly directed branches which give a little hint of a very feeble stalk-like part.

Another comparable form is *Indopolia satyavanti* Pia⁵ in which the primary branches resemble to some extent those of *Morelletpora*; but the form of the thallus and the presence of secondary branches, however, readily distinguish this from the Ranikot form. A fuller account will be published elsewhere.

I express my indebtedness to Prof. S. R. N. Rao for the guidance and the keen interest he evinced in this work; to Prof. T. M. Harris, F. R. S., for guidance in the study of serial sections and to Srimati Savitri Sahni for laboratory and library facilities at the Birbal Sahni Institute of Palæobotany.

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April 13, 1950.

C. P. VARMA.

* The work has been carried out with the help of a grant awarded by the Scientific Research Committee of the U.P. Government.

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STILPNOMELANE FROM BYRAPUR, HASSAN DISTRICT, MYSORE

DURING a recent visit to Byrapur Chromite Mines, an interesting type of quartz-chlorite schist was noticed containing a peculiar micaceous mineral developed all along the contact of the ultra-basics with the gneisses.

This mineral is brown in colour with a more or less metallic lustre exhibiting the typical micaceous structure. But, unlike mica, the folia are inelastic and brittle. Thus it would seem to resemble vermiculite; but unlike vermiculite it does not expand on sudden application of heat, although a change in colour is noticeable. This mineral is now identified as stilpnomelane which has not been reported so far in India, except for just a mention recently by A. K. Saha¹ of its possible occurrence in the dolerite sills, south of Katigutu, Chaibasa. Its optical characters are set forth in this paper.

Microsections of the rock show the mineral stilpnomelane occurring in association with quartz, talc, anthophyllite and chlorite. The mineral occurs in radiating or sheaf-like aggregates and is intimately interlaminated with chlorite from which it seems to be in the process of developing. It occurs as well-defined micaceous flakes exhibiting good cleavage but the cleavage traces are not so regular or continuous as in micas. It shows positive elongation and a distinct pleochroism with the following scheme:—

X = Yellowish.

X < Y = Z.

Y = Z = Reddish brown.

The extinction is parallel to the cleavage as in micas. Typically the mineral is uniaxial and negative but occasionally a slight breaking up of the cross is seen on rotation of the stage thereby giving a distinctly biaxial figure with a small optic axial angle. Refractive indices as determined by the immersion method are as follows:—

$$\alpha = 1.605$$

$$\gamma - \alpha = 0.090.$$

$$\beta = \gamma = 1.695.$$

The birefringence of the mineral as determined by Berek's compensator is 0.089. Thus, it is seen that this mineral has got a strong resemblance to biotite in optical characters.

Though this mineral resembles a chlorite or a vermiculite in physical properties or a biotite in optical characters, a closer examination of its optical characters reveals that it cannot be any one of these minerals. On the other hand, there is a very close resemblance between it and the minerals of the stilpnomelane group.

as indicated by the very high birefringence, 0.090, which is the most important and characteristic optical feature of the stilpnomelane group of minerals,² as shown in the following table:—

Birefringence

Chlorite	0.000 to 0.015
Vermiculite	0.020 to 0.030
Biotite	0.030 to 0.060
Stilpnomelane ..	0.043 to 0.110
Micaceous mineral from Byrapur (stilpnomelane)	0.090

Besides the optical characters, this mineral also resembles closely the minerals of the stilpnomelane group in its mode of occurrence. Here it occurs in intimate association with talc, anthophyllite and chlorite and thus resembles the stilpnomelane of the iron formations of Cuyuna and Mesabi ranges of Minnesota,³ where a similar mineral assemblage has been noticed. It is also observed that this mineral occurs intimately interlaminated with chlorite from which it is seen to be developing, this transition being more evident round about magnetite grains. Such a feature has also been noticed in the minerals of the stilpnomelane group from Western Otago, New Zealand.⁴ The associated characteristic mineral assemblage indicates that this is a mineral of the low grade metamorphism in which stress has been the dominant factor.

In the early days, the presence of the minerals of stilpnomelane group had been overlooked, on account of their general resemblance to biotite. It is only recently that (Hallimond,⁵ 1924; Hutton,⁶ 1938; Gruner,⁷ 1937 and 1944) a detailed investigation of the chemical composition, optical characters and X-ray analysis of stilpnomelane and related minerals has been made as a result of which a separate and distinct group namely "Stilpnomelane group" has come to be recognised in Mineralogy.

Rough chemical data, however, can be read off from the variation diagram, given by Hutton⁸ for the stilpnomelane group of minerals. Computed from this variation diagram, the mineral from Byrapur is seen to contain 47% (Fe, Mg, Mn)₂O molecule and 53% (Fe Al)₂O₃ molecule. Therefore this mineral, being a ferric-rich variety, is identified as stilpnomelane.

It is evident from Hutton's⁹ study of the analyses of the stilpnomelane from the Western Otago schists of New Zealand that these minerals, unlike biotite, are characterised by a low percentage of K₂O and a high Fe₂O₃. The actual chemical analysis of the mineral

from Byrapur is expected to confirm its identification as stilpnomelane now made on the basis of its optical and other characters. Further work is in progress.

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HETEROGENEOUS OLEFINIC NATURE OF ALIPHATIC SIDE CHAIN OF THE MONOPHENOLIC CONSTITUENT OF COMMERCIAL RAW CASHEW NUT SHELL LIQUID

THE monophenol obtained by vacuum distillation, after decarboxylation, of commercial raw cashew nut shell liquid, extracted by heat treatment of the whole nut shells, was shown by Wasserman and Dawson¹ to be 3-pentadecadienyl phenol (cardanol), chemically identical with the monophenol obtained by earlier investigators² by decarboxylation of anacardic acid got by solvent extraction of the shells of the nut.

Later, however, Slettinger and Dawson³ observed that repeated distillation of methyl ether of the monophenol resulted in the reduction of the number of double bonds in the side chain from 2 to 1.56, and concluded to the phenol being in fact a mixture of mono-, di- and possibly higher olefinic components, the loss of unsaturation being attributed to selective polymerisation of the higher olefinic components.⁴

Experimental evidence of a different type is here presented as to the heterogeneity of the olefinic character of the aliphatic side chain of the phenol, obtained from iodine numbers of various samples from the commercial liquid distilled at different pressures. The results are presented in Table I which contains in each column the pressure in mm. Hg at which

TABLE I

Dist. Press. in mm.	..	2	5	20	30	60	100	200	760
Iodine Number	..	331.0	325.6	321.2	319.8	307.7	300.1	284.0	229.2
Double Bonds	..	1.95	1.85	1.79	1.76	1.63	1.55	1.36	0.71

distillation, after completion of decarboxylation, of the commercial liquid was carried out, the iodine number of the sample obtained and its calculated average number of double bonds per molecule.

In calculating the iodine number from results obtained by using Woburn solution,⁵ it was assumed, on the basis of evidence adduced by Wasserman and Dawson,¹ that the side chain did not suffer any rupture during distillation, so that the same molecular weight of 300 could be assigned even to the less unsaturated samples without introducing substantial errors. Furthermore, in deducing the number of double bonds, correction was made for the substitution of four hydrogen atoms in the nucleus by halogen atoms, justification for this being the very reactive nature of these positions in the phenolic nucleus with unsaturated aliphatic side chain in meta-position. It must, however, be added that these assumptions might not necessarily hold good in the case of atmosphere distilled sample which shows an abnormally low unsaturation.

The decrease in the average number of double bonds with increase in distillation pressure and consequent increase in temperature, seems to be due to progressive polymerisation, aided by increased temperature of di- and higher olefinic components, as substantiated to some extent by a corresponding decrease in percentage yield of the phenol. For instance, a rough estimation of yield of phenol compared to the raw liquid taken, is 62% at 2 mm., 57.5% at 100 mm., 55% at 200 mm., and 50% at atmospheric pressure.

Further chemical investigation of the samples distilled at different pressures is in progress.

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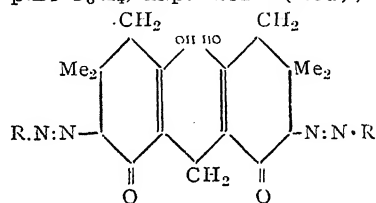
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AZOFORMALDIMETHONE DYES

LIKE methone,¹ formaldimethone (methylenebismethone) possesses phenolic properties and couples readily with diazonium compounds to give dyestuffs (for which formula I is provisionally assigned) ranging in colour from vermillion red to violet. The following dyestuffs have been prepared in this manner starting from the appropriate amines:

- (1) R=C₆H₅, m.p. 138-9°, (vermillion red);
- (2) R=p.Br C₆H₄, m.p. 202° (Red);



(I)

- (3) R=O-tolyl, m.p. 125° (Red); (4) R p-xylyl, m.p. 132-3° (Red); (5) R=1:2:3-xylyl, m.p. 125-7° (Red); (6) R = α-naphthyl, m.p. 135° (Dark Red or Brownish Red); and (7) R=β-naphthyl, m.p. 198° (Red=Violet). These compounds are crystallised from alcohol. Experiments on reduction of some of these dyes and dyeing properties on wool and silk are in progress.

Our thanks are due to Prof. P. C. Guha for his kind interest in the studies.

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THE POSSIBLE ASSOCIATION OF COLIFORM BACTERIA WITH CLOSTRIDIUM LACTO-ACETOPHILUM IN NATURE

A PREVIOUS communication gave¹ a detailed account of *Cl. lacto-acetophilum*, a strict anaerobe fermenting lactate. This organism in pure cultures was shown to depend upon added acetate for its growth and for the fermentation of lactate, whereas in crude enrichment cultures it was reported to have grown vigorously and fermented lactate despite the fact that the

enrichment culture medium did not contain any added acetate beyond about 3-5 mg./100 ml. introduced therein in the form of yeast-autolysate used as an ingredient. From several experiments it was concluded then, that in the enrichment cultures some other factor, possibly a second organism, was operating with the *Clostridium* in such a way as to make the addition of acetate unnecessary.

Further evidence in support of this view was derived from experiments carried out with radio-active C^{14} .² In pure cultures the *Clostridium* fermented lactate, but did not utilize CO_2 * provided in the fermenting medium in the form of labelled bicarbonate; consequently the fatty acids formed were inactive. In the enrichment cultures, on the other hand, not only the resulting acids were found to be specifically active but that the labelled CO_2 * was clearly shown to have been utilized in the process. This clearly indicated that *Cl. lacto-acetophilum* by itself cannot utilize CO_2 and that in the enrichment cultures some other species must be involved in the fermentation of lactate.

Attempts to isolate the associating organism resulted in the isolation of nine cultures of Gram-negative, non-sporulating, non-capsulated bacteria from four cultures set up with three different samples of soil. These bacteria on complete identification could be placed among the Coliform bacilli; eight cultures agreed well with *E. freundii* and the remaining culture was characteristically that of *A. aerogenes*.³ When, however, the *Clostridium* (Strain No. 3 on which all previous work has been carried out) was grown in association with these nine cultures separately by the glass-stoppered bottle method, it was observed that the disappearance of lactate from the mixed cultures was in greater quantities than that observed from the corresponding control samples where either the *Clostridium* alone or the nine bacteria were acting separately. Whereas the *Clostridium* could decompose lactate in quantities varying from 41 to 59 mg./100 ml. of the culture in 5 days, the Coliform bacteria from 93 to 158 mg. during the same period, in mixed cultures quantities ranging anywhere between 392 and 509 mg./100 ml. were decomposed during the very same period. Moreover, the growth of the *Clostridium* was observed to be much better in the presence of these Coliform bacteria. It was, however, repeatedly observed that even then the mixed culture was not comparable in vigour with the natural enrichment culture.

A further attempt was made to see if the two organisms can grow in association under somewhat altered conditions. The mixed and the pure culture sets were made in the enrichment medium in a series of Smith's fermentation tubes provided with aerobic plugs and incubated at 37° C. for 5 days as before. The *Clostridium* by itself failed to grow under these conditions; the Coliform bacteria grew well and produced from lactate pure acetic acid as the metabolic product. In mixed cultures, however, the *Clostridium* did grow, though less vigorously than in the bottle cultures, and even produced butyric acid, its characteristic product of metabolism. The ratio of butyric to acetic acid was, however, only 0.25 to 0.33 as compared to the enrichment cultures or the pure cultures wherein the ratio was as high as 1.1 to 2.6. This observation justifies one in pointing out the Coliform bacteria as the organisms operating in the enrichment cultures with the *Clostridium*, but they certainly do not appear to be the *only* species concerned. (The ability of the Coliform bacteria to utilize CO_2 is another point in support of this view.) Probably there is one more partner concerned in the process but not yet isolated, or it may even be that the *only* associant has slipped through these isolations and may be trapped on a future occasion.

Further work is in progress and these results are in the meantime offered for comments and suggestions.

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THE METABOLISM OF RATS RECEIVING CHOLINE AT DIFFERENT LEVELS

The lipotropic activity of choline has now been attributed to its ability to increase the rate of turnover of phospholipids in the liver.^{1,2,3} Choline has also been shown to be the donor of methyl groups for the biosynthesis of methionine.^{4,5} The ability of choline to accelerate the rate of turnover of phospholipids prompted investigation as to whether it exercises any influence on the metabolism of nitrogen, phosphorus and sulphur in rats fed on a diet deficient in lipotropic factors, and

designed to cause fatty infiltration of liver in rats.

Twelve rats of the Haffkine inbred strain were divided into three groups of which the second and the third were fed choline chloride at 100 and 250 milligrams per cent. respectively, for a period of 18 days during which collections were made for analysis for each three-day period separately. Table I summarizes the

TABLE I

Influence of choline on the metabolism of rats

	Control	100 mg. choline chloride per cent.	250 mg. choline chloride per cent.
Increase in weight of rats (grams)	2	7	7
Total food intake (grams)	85.75	88.22	92.23
Nitrogen metabolism:*(mg.)			
Urinary nitrogen	81.1	46.4	97.7
Faecal "	117.86	118.24	109.04
Retention	762.39	823.36	826.21
Phosphorus metabolism:*(mg.)			
Urinary phosphorus	46.0	27.0	54.0
Faecal "	52.96	54.53	62.60
Retention	432.69	465.48	455.33
Sulphur metabolism:*(mg.)			
Urinary sulphur	7.83	6.31	7.97
Faecal "	20.01	20.96	21.74
Retention	-2.11	-0.80	-2.04
Analysis of liver:*(grams)			
Fresh weight	4.44	4.87	4.80
Weight of liver as per- cent. of body weight	6.34	6.37	6.27
Fat content of liver	0.7080	0.2875	0.3620
Fat per cent. of liver	15.95	5.90	7.54

* The figures for metabolism are for the total period of the experiment.

results of the experiment and indicates that while the lower level of choline supplement brings about a distinct sparing action on all the three constituents investigated, the higher supplement just reverses it, raising the total for the period of experiment to a little higher than that in the control group. The analysis of the livers of the rats in the experiment showed that the fat percentage at both the levels of choline supplement was almost the same, though there ought to have been a further decrease in the fat content in the liver if the lipotropic activity of choline is dependent on its availability for phospholipid formation. This negative result leads to the suggestion that the lipotropic activity of choline may be just an intermediary process for transporting choline to the site of metabolism without acetylation and that choline may have

some other more important function in metabolism different from its role as a donor of methyl groups for the formation of methionine or creatinine.

Further communications in elucidation of this point will follow.

My thanks are due to Major-General Sir S. S. Sokhey and Dr. K. Ganapathi for facilities to continue this investigation.

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ON THE CARENES IN INDIAN TUR- PENTINE OIL FROM *PINUS LONGI- FOLIA* ROXB.

THE possible existence of an additional, unidentified terpene apart from Δ^3 -carene described by Simonsen¹ in the carene fraction of the oil from *Pinus longifolia* is evident from the work of Dupont² and Joffre.³ That this is probably β -carene is suggested by the production of formaldehyde on ozonisation of the carene fraction, and the isolation of the semicarbazone of the ketone, $C_{10}H_{14}O$, m.p. 210–11°.⁴ Equally in harmony with the above facts are the results of study of the Raman effect in Δ^3 -carene of the oil.⁴ Hence, the report of Guha and Roy⁵ on the presence of Δ^4 -carene in a fraction b.p. 164–68°/680 mm. of the oil distilled by them appears rather surprising. As no concrete evidence is given for this, and as Δ^4 -carene does not yield well-authenticated crystalline derivatives, it is suggested that due consideration be given to their findings before justifying Δ^4 -carene as an additional constituent of the oil.

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A MOSAIC DISEASE OF *CROTALARIA MUCRONATA* DESV. (*C. STRIATA* DC.)

A MOSAIC disease of *Crotalaria mucronata* Desv. (*C. striata* DC.) has been commonly observed at the Indian Agricultural Research Institute.

It starts on the youngest leaves in the form of pale areas, occasionally with a slight downward curling of the tips of affected leaves. This curling disappears later and typical mosaic mottling appears on the lamina and a few pale interveinal areas are observed on the older leaves. Unlike in the mosaic disease of *Crotalaria juncea*,¹ the leaf size is rarely reduced and abnormal growth of the lamina associated with blistering of the leaf is not met with (Fig. 1).

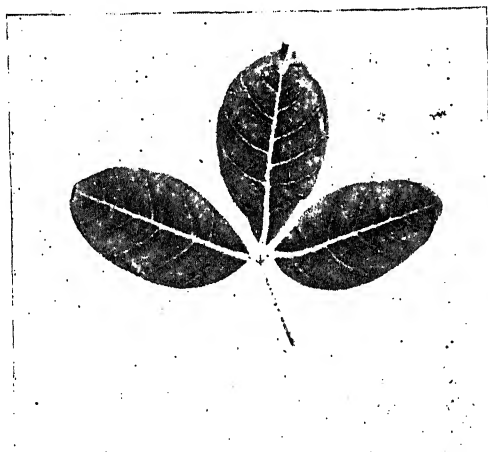


FIG. 1. mosaic-affected leaf of *Crotalaria mucronata*.

The disease can be readily transmitted by sap-inoculation to *Crotalaria mucronata*, *C. juncea*, *Vigna sinensis*, *Phaseolus mungo* and *P. aureus* and the symptoms appear within seven to twelve days after inoculation. The virus could not be transmitted to *Cajanus cajan*, *Vicia faba*, *Nicotiana tabacum*, tobacco var. White Burley and *Lycopersicum esculentum*.

The virus has a thermal death-point of 80°-85°C., a longevity *in vitro* of 134-142 days when stored at 12°-15°C. and in crude sap can tolerate a dilution of 1:20,000 to 1:30,000.

Cook² observed a mosaic disease of *Crotalaria mucronata* which is responsible for the dwarfing of the plant and reduces seed production, but is not seed-borne. The effect of mosaic on cell structure and chloroplasts in this plant was also studied by Cook.³ Phyllody was observed by Cooper⁴ on the same host in Bombay. Recently Capoor⁵ described 'Southern sannhemp mosaic' virus from Poona which is

transmissible to many species of *Crotalaria* including *C. mucronata*. This virus is quite distinct from the mosaic reported herein.

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February 21, 1950.

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ON THE BREEDING HABITS OF THE RIBBON FISH

TRICHIURUS HAUMELA* (FORSK.)

ALTHOUGH ribbon fishes provide an important fishery along the east and west coasts of India, their shoaling, breeding and spawning habits have not been investigated in detail. Venkatraman⁶ gave a short account of the feeding habits of ribbon fishes of the Malabar coast, and Chidambaram and Venkatraman¹ dealt with the natural history of ribbon fishes.

A detailed investigation on the minimum size at maturity and the spawning habits of the common Madras species, *T. haumela*, was undertaken during the period 1947-49. Observations based on about a thousand specimens of this species show that it is sexually mature when it attains a length of 47-48 cm. The age at maturity could not be determined from the inconspicuous growth zones on otoliths, nor are scales present in ribbon fish for study of growth rings. The occurrence of gravid ribbon fish in April and May and their reappearance in spent condition in July lead to the conclusion that the former have spawned in the interval. This inference is confirmed by the study of the diameters of 1300 ova in sections of ovaries in the last and penultimate stage of maturity, and is supported by work on similar lines by Hickling and Rutenbergh.⁴ The fact that maturing eggs are sharply differentiated from immature eggs makes it probable that spawning is restricted to a definite and short period. The non-occurrence of the eggs in the plankton and of the spawning adults of Stage IV (of the International Council for the Exploration of the Sea) in the coastal waters seem to show that the species breeds probably in the off-shore waters. Devanesan and Chidambaram³ and Jacob⁵ have, however, recorded, in plankton collected in October 1939, eggs of what they believed to be ribbon fishes. The eggs of ribbon fishes are so remarkably

alike that it is very difficult to refer them to their respective species until their development is followed to the stage at which specific differentiation is possible (*vide* Delsman, 1926). As no developmental details are provided by them, it is open to doubt if the eggs recorded by them belong to *T. haumela* at all. Jacob⁵ suggests the possible occurrence of two spawning seasons or a single prolonged one. The present observations do not support his suggestion.

Volumetric analyses of the gut contents for a continuous period of one year indicate that feeding activity of *T. haumela* increases soon after spawning. Besides prawns and white bait which constitute their favourite food⁶ the following have also been found in the gut:—*Caranx* spp., *Dussumieria* spp., *Sardinella* sp., *Kowala thoracata*, *Mugil* spp., *Equula* sp., *Gazza* sp., and *Trichiurus* spp. Among the crustaceans the most common were *Penaeus* spp., *Mctapenaeus dobsonii* and *Acetes* sp. Young ones of *Sepia* constitute the rarer items of food. During intensive feeding, *T. haumela* seems to develop cannibalistic tendencies judging from the large number of mutilated individuals of the same species which clog the gut.

A detailed account of these investigations will be published elsewhere.

My thanks are due to Dr. H. Srinivasa Rao for his guidance and encouragement.

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May 19, 1950.

* Published with the kind permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp, South India.

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A NEW BIOTYPE OF RACE 15 OF *PUCCINIA GRAMINIS TRITICI*

UREDIA of susceptible type were noticed on Charter in the field plots at Mahabaleshwar during the severe epidemic of stem rust of wheat (*Puccinia graminis tritici*) in 1946-47. The fact that Charter was resistant to the physiologic races of this rust known to

occur in India till then,^{2,4} made the writer suspect the presence of a new race. Uredospore material, multiplied on the seedlings of N.P. 4, was utilised for inoculating the seedlings of Charter, raised in a rust-free room of the glass-house. The resulting reaction was of a susceptible type, whereas the same variety proved resistant when inoculated with a mixture of the known races. Single-spore culture of the new isolate, established on N.P. 4, when tested on the twelve standard differential wheat varieties, showed that the reactions produced by the new isolate closely agreed with those produced by race 15, originally supplied by Mehta. Since Charter is resistant to race 15 of Mehta but susceptible to the new isolate, it is surmised that the new isolate is different from race 15 of Mehta, although both of them produced identical reactions on standard differential hosts. It is proposed to designate the new isolate as 15 C.

Stakman, *et al.*,³ have mentioned two biotypes, *viz.*, 15 A and 15 B within race 15. Rival wheat is resistant to 15 A but susceptible to the new biotype 15 C. According to Hart,¹ *Triticum timopheevi* is immune from race 15 A but susceptible to 15 B. It is, however, resistant to the new biotype. It seems clear that the new biotype of race 15 not only differs from race 15 of Mehta but differs from races 15 A and 15 B described by Stakman, *et al.*

Table I will prove that the new biotype is more virulent than race 15 of Mehta, since some of the exotic wheat varieties, resistant to all the previously known races of *Puccinia graminis tritici* in India, are susceptible to it.

TABLE I

Comparative reactions of some exotic wheat varieties to the known physiologic races of *Puccinia graminis tritici* in India and to the new biotype 15 C.

Wheat varieties	Reaction to races 15, 21, 24, 34, 40, 42, 42B, 75, and the unnumbered races A and B		Reaction to the new biotype 15 C.
	(Range of infection types)		
60B-12B-16L ..	0 to 2*	2 & 3	
Bobin x (Bobin x Gaza)	0 ,, 2	3	
C. 14112 ..	0 ,, 2	4	
Charter ..	0 ,, 2	4	
Gabo ..	0 ,, 2	3	
Gaza Q ..	0 ,, 1	4	

* Explanation of symbols:—0-immune, 1-highly resistant, 2-moderately resistant, 3-moderately susceptible and 4-highly susceptible.

Q—The only *durum* wheat resistant to all known races of stem rust in India except the new biotype 15 C.

Fortunately, the new biotype was not observed in nature for three years after its first appearance in 1946-47. Even then, it was present in a small proportion. The wheat varieties in Table I, which are resistant to the races occurring in India at present, have been used for breeding rust-resistant varieties for the states of Bombay and Madhya Pradesh. Since they are susceptible to race 15 C, the present programme of hybridization will have to be reoriented if it reappears in significant proportion. The object of this note is to draw the attention of the Wheat Breeders in India to this potentially dangerous race. Varieties like Kenya E. 144, C. 9906, 291. J.I.I., etc., are however resistant to the old races as well as the new one.

The writer is grateful to Dr. B. N. Uppal and Dr. M. K. Patel under whose guidance the work was done.

Wheat Rust Station,
Mahableswar,
February 4, 1950.

V. P. GOKHALE.

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ANTHESIS IN *CAJANUS INDICUS* SPRENG.

THE phenomenon of anthesis is a very interesting feature in plants and it has a great bearing in plant breeding work. Chandrasekharan and Parthasarathy¹ have reviewed the mechanism of anthesis in some of the Indian crop plants. The present note deals with anthesis in *Cajanus indicus*.

Observations were made during the months of December 1949 and January 1950 for determining the mode of anthesis in a particular variety of *Cajanus indicus* T no. 216-061, cultivated in the Hebbal Agricultural Farm, Bangalore. Anthesis in this plant takes place in the morning between 9 a.m. and 1 p.m., the maximum rate of anthesis being between 10 and 12 noon. During the time of anthesis the average temperature ranges from 27° C. to 32° C, the rate of anthesis being maximum between 29-31° C.

The actual opening of the anthers in a large number of flowers showed certain interesting features. The dehiscence of the anther takes

place longitudinally and usually the time taken for the complete anthesis of a stamen is about twenty minutes. In a stamen the two anther sacs open one after another. To start with an anther sac begins to open longitudinally from the distal end. During this process of longitudinal opening, the other anther sac also opens in a similar manner from the distal to the proximal end. The time taken for the complete anthesis in a stamen is twenty minutes and the various stages in the opening of the two anther sacs are shown in Fig. 1.

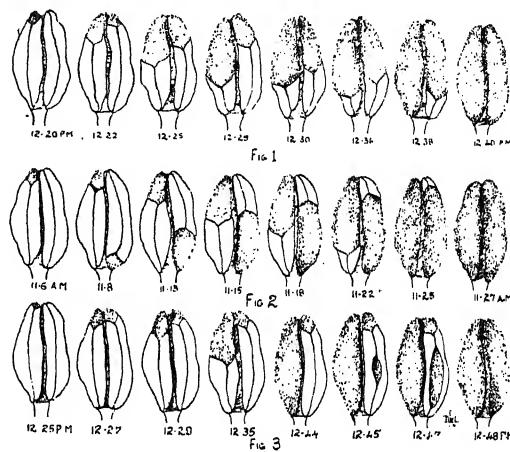


Fig. 2 shows a variation where while one anther sac opens from the distal end, the other opens from the proximal end. Sometimes it was noticed that if one anther sac opened longitudinally, dehiscence in the other anther sac had not at all progressed to an appreciable extent. In such cases (Fig. 3) a slit appeared in the middle of this anther sac and this gradually extended both distally and proximally, thus bringing about the dehiscence of this anther sac also.

Sincere thanks are due to Dr. L. S. Doraiswamy of the Department of Agriculture, for valuable suggestions, to Sri. A. K. Ramu for help in field observations and the National Institute of Sciences of India for the award of a Research Fellowship.

Department of Botany, K. SUBRAMANYAM.
Central College,
Bangalore 1,
July 3, 1950.

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TWO GRASS SMUTS

Dactylis glomerata is an introduced grass common in Ootacamund. A leaf smut was prevalent on this during the winter (November 1949 to February 1950). Numerous black sori were observed on the older leaves. The sori were amphigenous, minute, almost rectangular and limited by the veins, 0.25 to 1.50 mm. long and 0.1 to 0.3 mm. broad. The sorus lay between the two epidermal layers which did not rupture to liberate the spores but remained covering it. It was made up of a compact dark brown pseudoparenchymatous mass of spores closely adhering to one another and not easily separating. This mass occupied the whole space between the veins having displaced the host cells. The spores were polygonal by pressure, dark brown and smooth walled. They measured $13.5 \times 12 \mu$ ($12-20 \times 8-14$).

The fungus is an *Entyloma*. Two species, viz., *E. crastophilum* Sacc. and *E. dactylidis* (Pass.) Cif. have been recorded on this host. The latter smut was originally described as *Thecaphora dactylidis* by Passerini but Saccardo regarded it as a synonym of *E. crastophilum*. Ciferri however transferred the fungus to *E. dactylidis*. The local specimen was sent to Dr. Bisby of the Commonwealth Mycological Institute, England, for correct identification. Mr. M. B. Ellis of the same Institute who examined the material remarks that it is "better to refer the smut to *E. dactylidis*". The spores of the local specimen are slightly bigger than those described by Liro (1938). The name suggested by Mr. Ellis is adopted as there is agreement in all other characters. This smut has not been previously recorded from India.

Tragus biflorus (*T. racemosus*) is a common grass growing in Coimbatore. A smut has been frequently observed to infect this grass in the months of November to January. The sori are ovaricolous and appear as enlarged oval green bodies upto 4 mm. in length, in some of the spikelets of the inflorescence. One to six sori have been noticed in each ear. The sorus is provided with a tough green covering which eventually bursts, exposing the dark-brown powdery mass of spores. The wall of the sorus is made up of three or four layers of host cells on the outside. These cells contain chloroplasts and hence the colour is green. Internal to these lie several rows of hyaline hyphal cells. These appear as a whitish lining to the wall of the sorus. The spores are subglobose, olive-brown, echinulate and measure $10 \times 9 \mu$ ($8-14 \times 7-12$).

Ustilago tragana has been described by Zundel (1943) from Transvaal, on *Tragus*

racemosus. Mundkur (1944) has recorded *U. tragi* Mund. on the same host from Coimbatore. The latter is however only a later homonym. The smut under study agrees closely with the above and it is therefore identified as *U. tragana* Z.



FIG. 1. *Ustilago tragana* sori ($\times 2$)

The spores germinate quickly in 4 to 6 hours. The sparse formation of sori in the ear suggested that infection may be through the flower. In order to verify this, the grass was grown in pots and the ears were sprayed with a suspension of spores when the flowers opened or a suspension of spores was poured into the leaf-sheath while the inflorescence was still enclosed inside. After inoculation the pots were covered with bell-jars for a period of 72

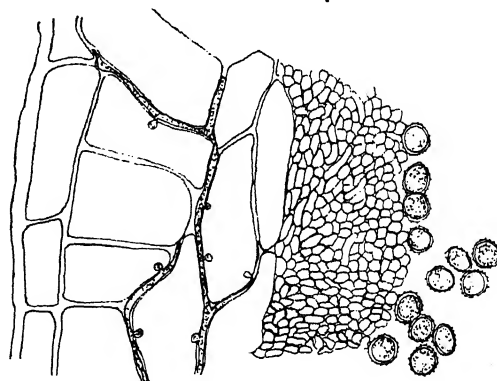


FIG. 2. *U. tragana*—Section of the wall of the sorus and spores ($\times 200$)

hours and later removed. On the twelfth and thirteenth days after inoculation sori appeared in the ears which were inoculated while still

enclosed in the sheath. Those that were inoculated after emergence and the controls were healthy. The experiments were repeated twice and the results confirmed. Hence in this smut the infection is through the young flower.

We are grateful to Dr. G. R. Bisby and Mr. M. B. Ellis for their kind help.

Agri. Res. Institute, T. S. RAMAKRISHNAN.
Lawley Road P.O., K. V. SRINIVASAN.
April 17, 1950.

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A REMARKABLE EXAMPLE OF MATERNAL SOLICITUDE IN A THRIPS FROM INDIA

MATERNAL solicitude in Thysanoptera has not so far been recorded. We recently came across a remarkable example of Brutpflege in a large common species of thrips, *Gigantothrips elegans* Zimmermann (Idolothripidae) at Agra.



FIG. 1. Female of *Gigantothrips elegans* Zimmermann, guarding her cluster of eggs. (Photo M. S. Mani)

The thrips breeds here in enormous numbers on the leaves of *Ficus glomerata* Roxb. during hot weather. The female lays a cluster of about two

dozen, oval, pale-brown eggs on the under side of the tender leaves. She then mounts guard over her eggs and 'sits' over them with the legs sprawling wide. She waves her long abdomen in a menacing attitude at frequent intervals as if to frighten any intending enemy. We saw her several times actually drive off small predatory mites that often stumble among the eggs. She remains in this attitude until all the nymphs have hatched. During the whole time of five to six days she never strays far away from the place of oviposition even for feeding. The beautifully striped young nymphs, which hatch first, also continue to remain under the protecting care of the mother. While thus brooding, if she is disturbed, she waves her abdomen with increased vigour, moves off to a distance but soon returns to her eggs, which she now proceeds to feel with her antennae as if to assure herself of their safety and then finally takes up her position once more on them. The leaves of several *Ficus glomerata* trees in the garden of the Zoology Department are covered by large numbers of broody females of this thrips. We include here a photograph of one of the brooding females.

Entomology School of Research, M. S. MANI.
Zoology Department, S. N. RAO.
St. John's College, Agra,
May 8, 1950.

INDUCED LYSIS IN THE GERMINATION OF THE UREDOSPORES OF THE WHEAT RUSTS

THE tendency of the promycelia of the chlamydospores from certain crosses to lyse has been demonstrated in case of *Ustilago zeæ* and *Sphacelotheca sorghi* by Chilton¹ and Laskaris² respectively. In both the cases the tendency to lyse was governed by genetic factor (or factors) and was characteristic of certain crosses in which the lethal factor (or factors) accounting were present in one of the parental lines and absent in the other.

While testing a home made hydrophobic colloidal sulphur spray for the control of wheat rusts, it was observed that germination of the uredospores of the black and brown rusts was inhibited on one per cent. water agar containing 20 parts per million of the fungicide. On water agar containing 10 p.p.m. of the fungicide, however, the spores of black and brown rusts produced germ tubes 10 to 15 μ long after 18 hours at 18°C. These germ tubes did not grow further, but got lysed, the protoplasmic contents extruding through the dissolved germ

tubes. In some spores, lysis occurred at the formation of the first rudiments of the germ tubes (Figs. 1 and 2), and even on water agar

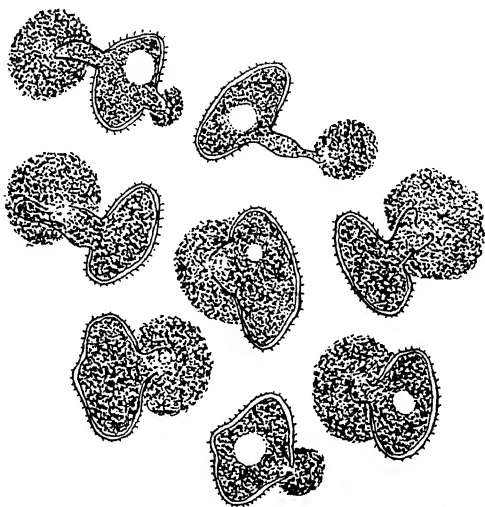


FIG. 1. Lysis of the germ tubes of the uredospores of *Puccinia graminis tritici*. $\times 430$. containing 2 p.p.m. of the fungicide although the average lengths attained by the germ tubes at this concentration were $35\ \mu$ and $75\ \mu$ for the spores of black and brown rusts respectively.

those in the control plates. In the case of yellow rust, the germination of the spores was inhibited on agar containing 2 p.p.m. of the fungicide, and lysis occurred on the medium containing 1 p.p.m. of the fungicide. The control plates showed normal germination in all the cases and, therefore, lysis of the germ tubes occurs because of the activity of the colloidal sulphur. A new term "Germinolytic" is proposed for such action of a fungicide which produces lysis of the germ tube.

The stock solution for home-made hydrophobic colloidal sulphur was prepared as follows:

One pound of powdered quicklime was slaked with half a gallon of water. To the slaking lime, two pounds of sulphur and half a gallon of water were added and the mixture boiled for about half an hour till the specific gravity of the mixture reached 1.28. Six hundred and fifty grams of molasses were then added and the whole stirred while still hot till the molasses dissolved. The solution was then decanted and stocked.

The author is grateful to Dr. R. S. Vasudeva, Head of the Division of Mycology, Indian Agricultural Research Institute, for suggestions.

Division of Mycology & M. L. GATTANI.
Plant Pathology,
Indian Agri. Res. Institute,
New Delhi,
April 15, 1950.

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CONTROL OF LOOSE SMUT OF BARLEY

TOTAL area under barley in the Indian Union in 1946 has been reported to be 6,247,000 acres and the production to be 1,958,000 tons. Incidence of loose-smut of barley [*Ustilago nuda* (Jens.) Rostr.] varies from field to field and may be 10 per cent. or higher in severely infected fields, but at a conservative overall estimate the incidence of the disease may be put at 1 per cent. resulting in a loss of 19,580 tons. Taking the price of barley at Rs. 7 per maund the total loss would amount to over 38 lakhs of rupees.

For the control of loose-smut of barley solar heat treatment recommended by Luthra² for loose-smut of wheat *Ustilago tritici* (Pers.) (Rostr.) has been successfully employed. Infected barley seed was obtained through the

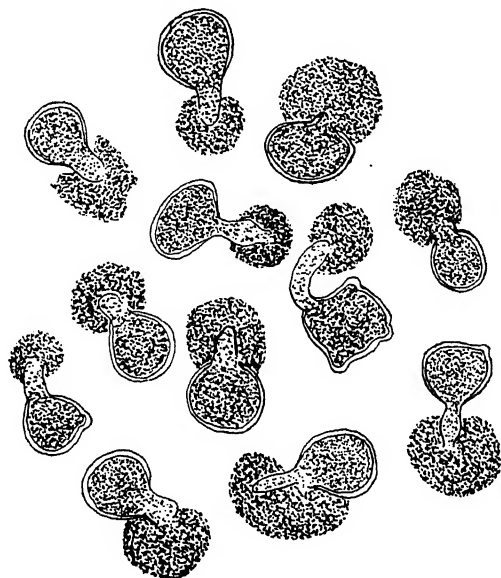


FIG. 2. Lysis of the germ tubes of the uredospores of *Puccinia triticea*. $\times 430$.

On water agar containing 1 p.p.m. of the fungicide, the germ tubes of the spores did not show any appreciable lysis but were smaller than

courtesy of Dr. S. M. Sikka in 1949. The seed was soaked in cold water on 23rd June 1949 from 6 a.m. to 10 a.m. and later exposed to the sun on a brick-floor from 10 a.m. to 5 p.m. The temperature of the floor during this period varied from 114.8° F.-129.2° F. but for a short period touched 132.8° F. The air temperature 4 inches above the ground level during this period varied from 105° F. to 111.2° F. The seed so treated was stored till 17th November 1949 when it was sown in two plots in the experimental area of this Division. The untreated seed was simultaneously sown in the adjoining plots. The percentage disease incidence in both the treated plots was nil as against 6.0 and 6.8 in the two untreated control plots.

It is observed that the disease can be fully controlled by solar treatment. The germination of the exposed seeds is, however, slightly reduced. It should be possible to make up the reduced germination by raising the seed-rate. Further experiments are, however, in progress to adjust the treatment in such a way that the germination is not impaired.

Div. of Mycology &

Plant Pathology,

R. S. VASUDEVA.

Ind. Agric. Res. Inst.,

M. R. SESHADRI IYENGAR.

New Delhi,

April 24, 1950.

1. *Estimates of Area and Yield of Principal Crops in India, 1936-46.* Directorate of Economics and Statistics. Ministry of Agriculture, Government of India, 1948.
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THE INHIBITORY ACTION OF GLUCOSE ON THE MECHANICAL RESPONSE OF UNSTRIATED MUSCLE

SINGH AND SINGH (1949) have shown that sometimes glucose, instead of increasing, inhibits the mechanical response of unstriated muscle produced by stimulating it with alternating current. A method has been found by which the inhibitory action of glucose can be

invariably obtained. Transverse pieces of frog's stomach muscle are stimulated every minute with alternating current, 12 volts for 10 seconds at 20-25° C. The muscle is then poisoned with sodium cyanide (1 in 100,000). 0.1 p.c. glucose is now added, when a temporary inhibitory effect is produced (Fig. 1). As the inhibitory effect is disappearing or has disappeared, removal of glucose produces a diminution of the response, showing that the effect has now become stimulatory.

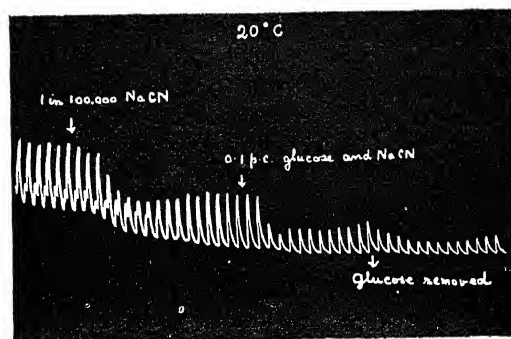


FIG. 1. Frog's stomach muscle. Stimulated with alternating current 12 volts/10 sec. per min. Effect of sodium cyanide (1 in 100,000) and 0.1 p.c. glucose at 20° C.

These results show that when the muscle is poisoned with 1 in 100,000 sodium cyanide, the energy for contraction is derived from a non-glycolytic source, as the action of glucose is inhibitory. Presence of glucose changes the metabolism, as shown by the recovery from inhibition; glucose is now utilised. This is shown by the fact that these effects of glucose are absent if the muscle is poisoned with the iodoacetic acid.

Physiological Laboratory,

Medical College,

Agra,

May 5, 1950.

SUNITA INDERJIT SINGH.

INDERJIT SINGH.

1. Singh, S. I., and Singh, I., *Proc. Ind. Acad. Sci.*, 1949, 30, 215.

NEW OBSERVATORY AT MADRAS

KODAIKANAL Observatory is to have a city station at Madras. A 20-inch Grubb reflector has been donated by H. H. Maharaja Kumarsinhji of Bhavnagar. Construction of a dome has been approved by the Government. At the same time tests on seeing both day and night are under way to determine the suitability of

Kodaikanal itself for the installation of coronagraph equipment and a larger telescope.

Since the 20-inch will be among the largest telescopes in India, it seems a pity that it should be located in a large city.

—By courtesy of *Sky and Telescope*, June 1950

REVIEWS

The Presentation of Technical Information.
By Reginald O. Kapp. (Constable & Co. Ltd.,
10, Orange Street, London, W. C. 2), 1948.
Pp. xi + 147. Price 6 sh. net.

The recent Editorial appearing in the fifteenth volume of the Penguin Science News, deplors "the inability of most British Scientists to write even a proper scientific paper, let alone a popular article". It adds that this "is now causing such general concern that a number of big firms and scientific societies are appointing advisers in English literature to help their inarticulate colleagues to express themselves intelligibly and with precision."

Many a good piece of scientific work or a technical advance, is lost to the world or remains obscure for want of clear presentation.

The volume under review, when judged in the light of the above remarks, constitutes an opportune and valuable contribution to the important and indispensable art of "conveying technical information from mind to mind". The book is based on a course of four lectures delivered by the author at the University College, London.

The subject-matter is presented in the course of fifteen lucidly presented chapters. The author emphasises the importance of avoiding "the language of meaningless, stereotyped phrases, involved syntax, cumbrous sentences in which much of our technical literature is cast."

The author enters an impassioned plea for the study and cultivation of what he calls Functional English—a style which enables us to express our ideas with clarity and precision and without ambiguity, thereby saving the readers unnecessary effort.

Apart from the controversial aspects of the place of English in the scientific and technological life of this country, it is generally admitted that English will remain as the medium of science and of international intercourse. It is, therefore, necessary that we, in this country, should cultivate an acceptable style for expressing our ideas and for achieving this end, the volume under reference constitutes an admirable introduction. We have no doubt that every scientific worker and technologist will eagerly read and assimilate the contents of this volume.

Radio Engineering, Vol. II. By E. K. Sandeman. (Published by Messrs. Chapman & Hall Ltd., London, W. C. 2), 1949. Pp. xxii + 579. Price 40 sh. net.

This volume is a continuation of Vol. I, and contains Chapters XVII to XXV and Appendix CI to CIX, a Bibliography and an Index. Chapter XVII is a very readable and simple description of balanced and unbalanced circuits highly useful to a beginner. Chapter XVIII is a long chapter on interference and noise, providing a wide variety of useful information. Chapter XIX is on radio receivers. This topic merits more attention in a book of this kind. The attention paid to different problems is rather meagre. Thus even the super regeneration receiver is disposed of in a page. The author has paid some attention to testing and this is the commendable part of this chapter. Chapter XX is on measuring equipment, Chapter XXI on equaliser design, and Chapter XXII on level range compression, etc. These chapters contain just the information that a book of this kind is supposed to incorporate. Chapter XXIII on feed back is of a very useful character for a beginner. This is followed by a long chapter on network theory and another, on filters.

Appendix CI to Appendix CIX cover nearly a hundred pages of the book, but many of them are quite useful and well done. The author will do well to cut out the more elementary mathematical parts in a subsequent edition.

The author has taken great pains to provide a long bibliography which he admits cannot be complete. An academic and research-minded individual would regard the choice of material as arbitrary and unsystematic. But the material provides a very useful indication of how a practical engineer engaged in the profession picks and chooses from the journals available to him.

The book contains a considerable amount of valuable information on the practical side, and as such is most useful and can be strongly recommended. It may be useful to apprentice engineers who get to the "job" without systematic education. But, it is not everywhere elementary enough to go into the hands of a beginner nor advanced enough to go into the hands of Honours degree students.

S. V. CHANDRASHEKHAR AiyA.

Non-Linear Vibrations in Mathematical and Electrical Systems. By J. J. Stoker. (Pure and Applied Mathematics Series, Vol. II.) (Interscience Publishers Inc., New York), 1950. Pp. 273. Price \$ 5.00.

The theory of non-linear vibrations has a much wider application than is generally recognised, for most natural systems have, in fact, a restoring force which is not strictly proportional to the displacement and they can only be treated as linear systems as an approximation. The approximation is good enough for many purposes, but there are cases where it is inadequate, since entirely new types of phenomena can occur in non-linear systems, which are unknown in the linear case. The occurrence of self-excited oscillations, for example in wireless circuits, the occurrence of forced oscillations when the external force is non-oscillatory, as in the flutter of airplanes or in the bowing of a violin string, and the occurrence of subharmonic forced oscillations and combination tones are typical examples in which non-linearity plays an important part.

The book under review contains an admirable account of the fundamental mathematical principles and methods which are employed for investigating non-linear systems. In this, the author has kept in view not only the needs of the applied mathematician, but also those of physicists and engineers. Although the standard of mathematics is quite high, the book can be read by anyone having a knowledge of ordinary differential equations. Recondite mathematical details, such as existence theorems, proofs of convergence, etc., are included in appendices, so that the main book is eminently readable. Starting with an introductory chapter on linear vibrations, the rest of the book deals with the free and forced oscillations of both damped and undamped non-linear systems. The last chapter is devoted to a discussion of Hill's and Mathieu's differential equations, which occur in connection with the stability of non-linear vibrations. The book will serve as an excellent introduction to the more advanced papers in the field.

G. N. RAMACHANDRAN.

the book fulfils a definite need—that of students of engineering sciences, other than electrical, who wish to know “something of Electronics and its applications” to their problems. The power of electronics in providing precise and versatile tools for observations and experiments in diverse fields—from aeronautical engineering to physiological phenomena—has transcended the dreams of even its most ardent enthusiast of over a decade ago. To-day, there is hardly any human activity where electronic has no role to play. This explains, perhaps, the author's attempt in explaining the necessity of adding one more to an overwhelming number of books published in recent years on the subject.

Admittedly then, the book is an elementary exposition of the fundamentals and electronic circuits. The first twelve of sixteen chapters cover various types of electron tubes, photo-sensitive devices, contact rectifiers, single and polyphase rectifier circuits, amplifier, oscillator circuits as also feedback and electronic control circuits. A chapter each is devoted to amplitude modulation and demodulation, cathode-ray oscilloscope and vacuum tube voltmeter. The outstanding chapter in the book is the one which deals with transducers of various types, of which the resistance strain gauge, differential transformer and the accelerometer are discussed at some length. This should be particularly useful to students of aeronautical engineering. An appendix deals with principle of the R-C discharge circuit. Problems are appended at the end of a few chapters.

The style of presentation is lucid, and the treatment sufficiently analytical for the class of students it caters for. A few problems are worked out in the book to illustrate the discussion employing typical circuit values encountered in actual practice. The book will indeed prove useful to those who wish to have a working knowledge of the subject.

The reviewer finds “Electronics in Engineering” as more apt a title for use, instead of such confusing names as “Electronic Engineering” and “Engineering Electronics”, for a course covering very much the same ground at practically the same level.

N. B. BHATT.

Electronics in Engineering. By W. Ryland Hill. (McGraw Hill Book Company, Inc., New York), 1949. Pp. 374. Price \$ 3.50.

“What? Another book on Electronics”? asks the author in the beginning of the preface, and while replying, feels convinced that

Rolling of Metals. By L. R. Underwood. (Chapman & Hall Ltd., London), 1950. Pp. xv + 344. Price 42/-.

The present volume represents a pioneer attempt to correlate widely dispersed published work on the rolling of metals on a scientific

level based on exact mathematical calculations and physical phenomena of what is now termed Mechanical Metallurgy.

The subject-matter has been methodically arranged and relates to the rolling of flat products. How vast is the field of rolling may be realized from the fact that the technique of rolling of circular shapes, of bars, angles and sections has not been referred to beside the technique of extrusion and other fabricating mechanical processes which fall within the field of Mechanical Metallurgy.

Dr. Underwood has to be heartily thanked by all students of Metallurgy for bridging a very wide gulf between what was regarded as merely rolling the material somehow and what the modern perfected rolling industry is to-day.

B. R. NIJHAWAN.

Modern Arms and Free Men. By Dr. Vannevar Bush (Heinemann). (Asia Publishing House, 17, Gun Bow St., Bombay), 1950. Pp. 299. Price 10 sh. 6 d.

This is a book, as its title implies, on the inter-relations of science, war and democracy; and it is written by one whose authority to deal with the first part of his subject is indisputable. For, Dr. Vannevar Bush, as Scientist-Chairman of the National Defence Research Committee in the U.S., was given war-time powers and funds unattainable by men of science in the past. The tremendous applications of science to war have completely altered warfare, and the process of change is rapid and continuous. Several chapters are given to a survey of the developments in the technique of war, with balanced forthright opinions on the limitations and possibilities of one scientific weapon after another. The treatment is comprehensive: war on land, in the air, on the surface of the sea and under the sea are all treated with the same sure command of the facts—or so it seems to the layman. A chapter on the atomic bomb was inevitable, and another on the implications of total war. Dr. Bush is out neither to allay our fears nor to frighten us. He wants us to know just what our position is, to be sensible about it, and to share his faith in democracy. For, democracy, a society of free men, is the main theme of the latter part of the book. Dr. Bush surveys skilfully the growth of the democratic concept and its imperfect practice in the U.S. He stresses the need for education at every stage, an education that keeps minds free, that trains all and yet trains the best minds, and that is strongly based on the fundamental sciences and

on the humanities. Such an education is the bulwark of democracy.

Dr. Bush has faith in his country and in her policies; on the other hand, he appears to have no patience with the view that anything really good can come out of regimented Russia. American thinking limits the sociological aspects of this work, while American enterprise and keen inventive genius animates the argument in matters of war and science. Everywhere there is evidence of a free-ranging mind, barring certain prejudices. A chapter to be recommended, for the stimulus it gives to one's own thinking, is Chapter XIII, where, to reinforce his argument that man must now choose between two opposing philosophies, he reviews in 'capsule fashion' life's progress and man's. It marks Dr. Bush as a man of vision and a great educator. His book will answer a need and may help to restore our faith in the democratic process which, despite its limitations, is the only road whereby mankind can hope to reach an adult civilised state of society. Of the strength of his own convictions, Dr. Vannevar Bush leaves you in no doubt. Whether he will strengthen yours is a matter he leaves entirely to your individual judgment.

Science News, Vols. 14 and 15. Edited by J. L. Crammer. (Penguin Books, Harmondsworth, Middlesex), 1949 and 1950. Pp. 158 & 194. Price 1 sh. 6 d. each.

Penguin Books have made history in the publication and popularisation of classics, modern literature and art which are brought within the reach of the common man. The series on Science News is an extension of the same commendable objective to the field of modern science which is making rapid and spectacular advances.

Exposition of scientific topics for the general reader is not an easy task and in recent years there has been a slow and steady demand for a class of science writers who can achieve this distinction. The Editor of the Penguin Science News has been able to discover and mobilise this exceptional talent and present to his readers a bunch of interesting and informative contributions.

The fourteenth volume contains among others, articles on television, the origin of the solar system, synthetic fibres and a symposium on bacteriophage. The fifteenth volume includes articles on rockets, measuring the universe, the blood of fleas, compound E, human colour vision and blood groups.

Each of the articles has been written by men who are entitled to speak with authority on their subjects. The volumes are well printed for comfortable reading and priced within the reach of every one aspiring to keep in touch with the latest advances in modern scientific thought.

Annual Review of Biochemistry, Vol. XVIII.

Edited By J. M. Luck and others. (Annual Reviews Inc., Stanford, California, U.S.A.), 1949. Pp. ix + 739. Price \$ 6.00.

The eighteenth volume of this pioneering series of Annual Reviews of Biochemistry follows the general pattern which distinguishes the earlier volumes and contains 23 chapters. Topics covering enzymes, carbohydrates, lipids, amino acids and proteins, nucleoproteins and nucleic acids, and vitamins are discussed both from the point of view of their chemistry and of their metabolism. The last three chapters relate to the chemistry and metabolism of plants. The rapidly expanding field of antibiotics has been reviewed by Wintersteiner and Dutcher. Wigglesworth has reviewed the subject of insect biochemistry—a topic which had not received attention since 1940. The stimulating and suggestive field of metabolic inhibitors has been ably reviewed by Winzler.

More than half of the reviews is contributed by American workers while only a third of them is reviewed by the British scientists. This is indicative of the intensive scientific activity of the American Laboratories. One would like to see contributions from the other European and Asian Laboratories in due course.

Advances in Carbohydrate Chemistry, Vol. IV.

Edited by W. W. Pigman and M. L. Wolfrom. (Academic Press Inc., New York, N. Y.), 1949. Pp. ix + 378. Price \$ 7.80.

This volume comprising ten contributions, is of particular interest in view of the varied aspects of carbohydrate chemistry, presented by the reviewers. The article on the Structure and Configuration of Sucrose is an attempt at marshalling strong and concordant evidence of the structure of sucrose in a convincing manner although a direct proof based on an unambiguous chemical synthesis is still lacking. Of interest to biochemists and immunologists is the article on Blood group polysaccharides, which concerns itself primarily with extractable haptens known as "blood group specific substances". Organic chemists interested in natural drugs will find Hudson's discussion on

Apiose and the Glycosides of the Parsley plant instructive and stimulating.

Biochemists will find Neuberg's comprehensive and thoughtfully planned contribution on the Biochemical Reductions at the expense of sugars, deeply interesting and inspiring. Organic chemists can discover in this article useful technique for the specific and selective reduction of certain groups which cannot be accomplished by other modes of reduction.

The difficult and wide field of plant gums and mucilages has been reviewed by Jones and Smith who have given a classification of the two natural products based on their chemical characteristics. Our present knowledge of the composition of some of the better known gums and mucilages have been given in this review.

Hexitols, which have not been so far reviewed and which have attained industrial importance have been discussed by Lohmar and Goepp Jr. Closely related to this is the review of Boeseken on the use of boric acid for the determination of the configuration of carbohydrates.

The volume contains two reviews of applied significance: (1) wood saccharification by Harris and (2) utilisation of sucrose by Wiggins, both of great interest to fermentation technologists who employ sugar as the fundamental raw material for the production of a variety of chemicals, including organic solvents and acids.

The series of volumes on the Advances of Carbohydrate Chemistry forms a valuable and a welcome contribution to the advancement of our knowledge in this field in its pure and applied aspects.

Technique of Organic Chemistry. Vol. I. 2nd edn. Physical Methods of Organic Chemistry. Parts I and II. Edited by A. Weissberger, (Interscience Publishers, New York). 1949. Pp. 2096. Price \$ 25.

The first edition, which appeared in 1945, comprised 736 pages, and the book has, therefore, been trebled in size in the new edition; a serious omission in the first edition was a subject index, and this has now been rectified. Thirty-two authors have contributed the following thirty-one chapters: (I) Temperature Measurement. (II) Temperature Control. (III) Determination of Melting and Freezing Temperatures. (IV) Determination of Boiling and Condensation Temperatures. (V) Determination of Vapor Pressure. (VI) Determination of Density. (VII) Determination of Solubility. (VIII) Determination of Viscosity. (IX) Determination of Surface and Interfacial

Tension. (X) Determination of Properties of Monolayers and Duplex Films. (IX) Determination of Osmotic Pressure. (XII) Determination of Diffusivity. (XIII) Determinations with the Ultracentrifuge. (XIV) Calorimetry. (XV) Microscopy. (XVI) Determination of Crystal Form. (XVII) Crystallochemical Analysis. (XVIII) X-Ray Diffraction. (XIX) Electron Diffraction. (XX) Refractometry. (XXI) Spectroscopy and Spectrophotometry. (XXII) Colorimetry, Photometric Analysis, Fluorimetry and Turbidimetry. (XXIII) Polarimetry. (XXIV) Determination of Dipole Moments. (XXV) Conductometry. (XXVI) Electrophoresis. (XXVII) Potentiometry. (XXVIII) Polarography. (XXIX) Determination of Magnetic Susceptibility. (XXX) Determination of Radioactivity. (XXXI) Mass Spectrometry.

Physical methods have become increasingly important to the organic chemist. The objects of the book under review and of the volumes which are to follow are to provide the organic chemist with a full account of tested methods, as well as the theoretical background for understanding them and for interpreting the results. These objects have been fulfilled in the first volume of the series with conspicuous success. The theoretical treatment is excellent, and description of apparatus and technique is thorough; the names of manufacturers (mostly American) have been mentioned for many instruments, and for some even the price. However, organic chemists, especially workers in branches of applied organic chemistry such as the technology of textile fibres, would have welcomed the inclusion of more information on the application of physical methods to problems in organic chemistry and technology. Thus, the very valuable and authoritative chapter of W. D. Harkins on surface and interfacial tension does not refer to wetting and detergency. Thermostats for low temperatures in the chapter on temperature control, the density of fine powders in the chapter on density, salting out of dyes, measurements of the solubility of gums, resins and other high polymers, the crystallinity and fine structure characteristics of macromolecular substances, and commonly available pH meters, are some of the topics justifying inclusion or further treatment. The writing of individual chapters by specialists in the field has obvious advantages; but this has also the disadvantages of some overlapping, disproportionate treatment of various topics, and lack of co-ordination. The chapters on the ultracentrifuge (110 pp.),

refractometry (100 pp.), spectroscopy and spectrophotometry (158 pp.) and polarography (100 pp.) are among the chapters which constitute comprehensive monographs, while the chapter on viscosity (27 pp.) has been written from the point of view of the special interests of the senior author (Mark). The chapter on polarography is especially useful because earlier reviews have been mainly concerned with its inorganic applications.

The printer and publisher have done their work exceedingly well. Reference 45 instead of 46 on p. 321 and cyclohexene instead of cyclohexane on p. 828 are the only two errors noticed during a rapid perusal. Although the price is high, it is not unreasonable, considering the size and importance of the book, and every research worker in organic chemistry will find that he must have a copy of his own, if he can possibly afford it.

K. V.

Bananas—Chemistry, Physiology and Technology. By Harry W. Von Loesecke. (Interscience Publishers, Inc., 215, Fourth Avenue, New York 3, N. Y. or Interscience Publishers, Ltd., 2 a, Southampton Row, London, W.C. 1), 1949. Pp. xi + 189. Price \$4.50.

The book is to be commended to the reading public and more particularly to those interested in fruit plants. The chemical changes during ripening have been exhaustively dealt with. The vitamin potency of the banana is fully described and the table on page 145 gives a comparative statement of vitamins present in the various important fruits and vegetables. The usefulness of this table would have been greater if other tropical fruits like the mango, the pineapple, etc., had been included in this table.

The author cites many references in regard to its origin. It is said in the last para on page 5 that the banana has probably originated in the Indo-Malay region. But in the second para on page 6 it is said that the banana was found growing in the Indus Valley in the year 327 B.C. The latter year being the earliest on record about the growing of banana, India should, therefore, be considered as the original home of the banana, and this view is supported by other evidence also.

The terms green banana and unripe banana are used for one and the same thing (page 130, lines 1 and 3). Even though the colour of the unripe fruit in most varieties of banana is green, the colour of the unripe fruit in some

varieties is purple or greyish white. The term 'unripe', therefore, seems the more appropriate for use than green.

On page 131, para one, methods of drying bananas are described. A layman may not be able to make out whether the ripe or the unripe bananas are meant. I may mention here that what is described in the first para is a method of drying ripe bananas while what is described in the second para is a method of drying unripe fruits.

There are a few printing mistakes : *come* for *some* (page 43, para 4). *Cocanut* for *coconut* (page 11, para 2, line 3). *Panchamruthan* for *Panchamrutham* ; *Palni* for *Palni* (page 135, para 2, lines 2 and 6).

K. C. JACOB.

Advanced Chemical Calculations. By S. J. Smith. (Macmillan & Co., Ltd., London), 1950. Pp. viii+454., 17/- net.

The book under review is a sequel to the author's 'Introductory Chemical Calculations' but of a far advanced character so as to fulfil the requirements of students taking the degree courses in chemistry, Pass as well as Honours. Ability to solve numerical problems is the most convincing test at our disposal to ascertain whether a student has fully understood the theory of the subject. There are very few books of this type in the field and this book in particular should be welcome to the teacher as well as the taught. I have often found that a majority of students avoid numerical problems or develop a dread for them and to such, this book should be of immense help. The book covers the different branches of the subject, namely, General, Analytical, Organic and Physical Chemistry and provides a comprehensive, unbiased and complete course in numerical chemistry. The opening chapter is intended to be a link between the older elementary book and the present advanced one. The succeeding chapters are all of an advanced character, each chapter giving a clear and succinct account of the theory followed by mathematical derivations relating to the portion covered in each. Choice worked-out examples provide sufficient guidance in the solution of problems contained in each chapter. Interspersed between the various chapters is a representative list of 'Miscellaneous Questions' taken mostly from the examination papers of various Universities. In a work of this kind there is always the possibility of stray errors creeping in and from a few examples chosen at random, I have

come across only one whose wording can be improved and which has a slip in the solution (Problem 79 *vide* Miscellaneous Questions, Chapters XIII-XV, page 294). From the data given, the compound (D) should be nitrogenous and further reactions of the compound mentioned establish it to be a primary amine

of the formula $\begin{array}{c} \text{CH}_3 \\ \diagdown \\ \text{CH}_2 \\ \diagup \\ \text{CH}_3 \end{array} \text{CH.NH}_2$ giving a secondary

alcohol and thence a ketone, whereas the formula given on p. 449, is $\text{CH}_3 \cdot \text{C}_6\text{H}_4 \cdot \text{COOH}$, which is evidently the formula for (E). The latter part of the problem is better worded as 'The compound (E) on oxidation gives an aromatic dibasic acid readily yielding the anhydride of the formula $\text{C}_8\text{H}_4\text{O}_3$.' This would enable the student to fix the formula of (E) and the nature of (F) as phthalic anhydride.

The compound (F) is $\text{C}_6\text{H}_4 \begin{array}{c} \diagup \text{CO} \\ \diagdown \text{CO} \end{array} \text{O}$ and not

$\text{C}_6\text{H}_4 \cdot \text{C} \begin{array}{c} \diagup \text{CO} \\ \diagdown \text{CO} \end{array} \text{O}$ as stated on p. 449 which gives

$\text{C}_6\text{H}_4\text{O}_3$ as the formula. The author should be congratulated on the production of a good book on numerical problems much needed at present, containing a wide choice of graded problems and every student of chemistry should possess this excellent book and make good use of it to stabilise his knowledge. M. V. S.

Flood Estimation and Control. By B. D. Richards. Second Edition. (Messrs. Chapman & Hall), 1950. Pp. xiii+173. Price 21 sh. net.

Since the success and safety of schemes involving the construction of dams and barrages depend largely on a correct estimation and control of floods, this subject is necessarily of great importance to an engineer. The engineers have to be grateful to the author for bringing within the compass of a book all the literature scattered in various publications. His approach to the subject is very original and thought-provoking.

In the development of the equation $t^3 = \frac{CL^3}{Kis}$ in Chapter V, the author assumes that in the flow from a catchment the depth 'd' will be very small compared to the width and 'r' will be equal to 'd'. He also assumes there is only one slope along which run off flows. All catchments will necessarily have two slopes, one from the water shed line to the gully formed in the valley between two hills, and another along the gully from its origin to the point of concentration. Thus, run off will have two

different velocities, initially along the side slope and later along the longitudinal axis of the gully. The ratio of depth to width in a gully is too appreciable to be ignored.

The Inglis formula as given on page 11 may be corrected to $Q = \frac{7000 A}{\sqrt{A+4}}$. It would be very in-

teresting if an example of calculating the peak flood according to his theory can be worked out for a catchment covering several thousand square miles.

The usefulness of the book will be enhanced if a chapter on estimating total run off can be added. Sri. A. N. Khosla's formula in this connection may be included.

N. S. GOVINDA RAO.

Indian Hill Birds. By Sâlim Ali. Illustrated by G. M. Henry (Oxford University Press), 1949. Pp. lli + 188, Price Rs. 20.

Bird watching is a fascinating, inexpensive and health-promoting past-time which lies within the reach of every scientific minded and enlightened individual. It entails bracing excursions to the countryside, visits to groves, forests and hills. The study of birds among whom are to be found some of the most beautiful of Nature's creations, involves a scientific elucidation of their habitat, their life-history, their song and their migratory instincts.

The volume under review is an excellent introduction to the subject of the study of birds in general and to the Indian Hill Birds in particular. It is written by one of the world's foremost authorities in ornithology. In the author's own words the book, "while conforming with all requirements of an up-to-date scientific work, is intended primarily for the non-technical bird lover".

About 300 species of birds are covered by the volume and these include those most likely to catch the eye or the ear of the hot-weather visitor to the Hill stations of India—Himalayan as well as Peninsular. More than thirty per cent. of the birds described, are beautifully illustrated in colour, specially painted for this work by Mr. G. M. Henry, the well-known bird artist. The Oxford University Press, the publishers, have to be congratulated on the beautiful get-up of the book and the artistic reproductions of the coloured plates.

We are confident that this authoritative volume will serve to inspire many more men and women to "swell the ranks of competent

bird watchers" and enrich the knowledge of birds in all its varied aspects.

Plant Pathology. By Sir Edwin J. Butler and S. G. Jones. (Macmillan & Co., London), 1949. Pp. 979. Price £ 3-3-0.

The present work is practically a new book, for it would not be correct to say that it is just a revision of Dr. Butler's earlier work (1918) with the substitution of some new diseases. The book would definitely have gained immense value if the diseases of crops like rice, sugar-cane, sorghum, corn, cotton, citrus, coffee and others which are important in many parts of the world, had been included in place of the diseases of trees and ornamentals. Even under the crops that have been dealt with, diseases like early blight of potato, etc., have been omitted because they are not of much importance in England. On the other hand, diseases like *Epichlœ typhina* (choke disease of grasses) are given undue importance.

Part one of the book deals with the general principles of plant pathology. It is exquisitely presented, containing a wealth of information and incorporating recent advances in our knowledge of the subject. In the second part, selected diseases of cereals, forage crops, root crops, pulses, vegetables, fruits, ornamentals and trees are described. The information presented is very valuable, and the illustrations are excellent and worthy of emulation.

In a book of this magnitude, it would be difficult to avoid small errors. Some obsolete names like *Asterocystis rudicis* (p. 11), *Macrosporium commune* (p. 31), *Exoascus minor* etc., are still retained. Under classification, the name *Ancylistales* (p. 331) is maintained instead of *Lagenidiales*, though *Ancylistis* is now known to be a *Zygomycete*. *Cystopus* and *Albugo* are misprinted as separate genera (p. 332). *Molinia* (grass) has been confused with *Monilia* (p. 333), which is the conidial stage of *Sclerotinia*. In the classification of rusts and in the placing of genera like *Phyllachora* and others, recent trends of research have been neglected. These remarks, however, do in no way detract the value of the book which contains a wealth of information and offers useful references to research workers in the field of plant pathology. The book is heavily priced, but it is hoped that it would be within the reach of all students of plant pathology.

M. J. NARASIMHAN.

SCIENCE NOTES AND NEWS

Occurrence of *Psilotum nudum* (L.) Griseb. (*Psilotum triquetrum* Sw.).

Sri. B. S. M. Dutt, Botany Department, P. R. College, Kakinada, suggests that as *Psilotum triquetrum* Sw. has been found in many places in Vizag, Godavari, Ganjam (author's collection in 1947), North Travancore (collection in 1944 by Mr. T. U. Chacko), Nilgiris, Coimbatore and Tinnevely,³ it may well be that its distribution in South India is not so scattered as was once supposed.^{2,4}

He collected it a few years ago from a forest near Vathangi (about 2,000 feet above sea-level), recorded in a paper by Venkateswarlu⁴; and recently, in three different places near Araku Valley, viz., Jilda (3,400 ft.), Galikonda (3,600 ft.) and Anantagiri (3,800 ft.).

The plants were 7-20 inches high. In Anantagiri, they were found in the hollow of a tree, but in the other two places the rhizome was either exposed on rocks or sunk in crevices near a water course. In Vathangi as well as in Jilda and Galikonda, specimens of *Gnetum* were also seen within 100 yds. of the *Psilotum*.

His grateful thanks are due to Prof. P. Maheshwari, University of Delhi, for going through the manuscript, and to Mr. M. B. Raizada of the Forest Research Institute, Dehra Dun, for identifying the plant and for much useful information.

1. Joshi, P. C., "Occurrence of *Psilotum* Sw. in the Punjab," *Curr. Sci.*, 1935, **3**, 486. 2. Mahabale, T. S., and Deshpande, G. S., "*Psilotum triquetrum* Sw. at Lonavla, Bombay Presidency," *Ibid.*, 1942, **12**, 466. 3. Raizada, M. B., "The Genus *Psilotum* in India," *Indian Forester*, 1935, **61**, 654. 4. Venkateswarlu, V., "On the Occurrence of *Psilotum triquetrum* Sw. in the East Godavari District," *Science and Culture*, 1944, **9**, 165.

Third Indian Pharmaceutical Congress

The Third Session of the Indian Pharmaceutical Congress will be held at Calcutta on the 30th and 31st December 1950, Dr. Sir J. C. Ghosh, Director, Indian Institute of Higher Technology, Calcutta, presiding. Reading of scientific papers and symposia on selected topics of pharmaceutical interest will form the main programme. The occasion will be utilised to establish contact on an international basis

among scientific workers interested in Pharmacy and allied sciences.

Tuberculosis Seals Sale Campaign

The Tuberculosis Association of India has decided to start a Tuberculosis Seals Sale campaign from this year. This campaign will serve not merely as a means of raising funds but also as a medium of health propaganda. The Stamps Sale in India is designed to give every individual an opportunity to contribute his or her mite to the anti-tuberculosis campaign. The money collected by this method will be used for the extension of the activities of both the Central and State Associations in different parts of the country.

The Seal Sales Campaign is scheduled to start on 1st October 1950, and end with a Tuberculosis Week in January, 1951. The Central Association will distribute to the State Associations Stamps required by them for the campaign. The target for this year's campaign is the sale of one million sheets of 35 stamps each.

Production of Radio-Active Isotopes

The British Ministry of Supply state that there has been an enormous increase in both the quantity and variety of radio-active materials being produced at the Atomic Energy Research Establishment at Harwell for industrial, medical and academic purposes. The total of consignments during the year was 3,443. About half the shipments consist of irradiated materials which do not have to be chemically processed. The other half are chemically separated in the laboratories. Some of the heaviest buyers of British-produced isotopes are Australia, South Africa, Sweden, Switzerland and Holland.

Award of Research Degree

On the recommendation of the Board of Examiners consisting of Prof. Robert S. Mulliken, Prof. W. Jevens, and Prof. R. W. B. Pearse, appointed to adjudicate on the thesis entitled "Studies in the Complex Spectra of certain Atoms and Diatomic Molecules," the Syndicate of the Andhra University have resolved that Mr. V. Ramakrishna Rao, M.Sc., be declared qualified for the degree of Doctor of Science.

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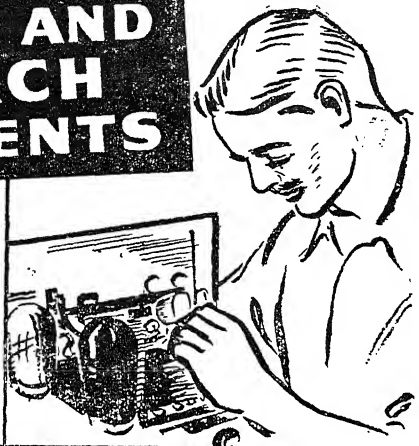
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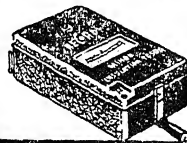
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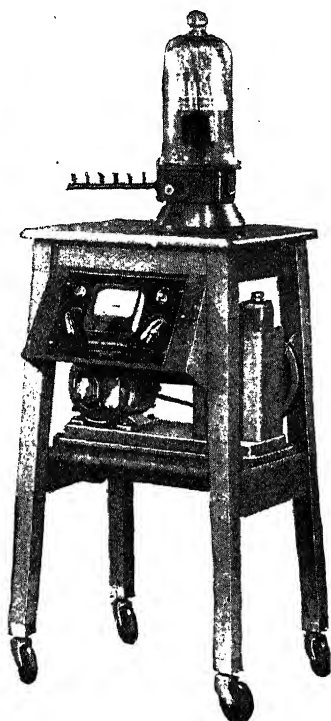
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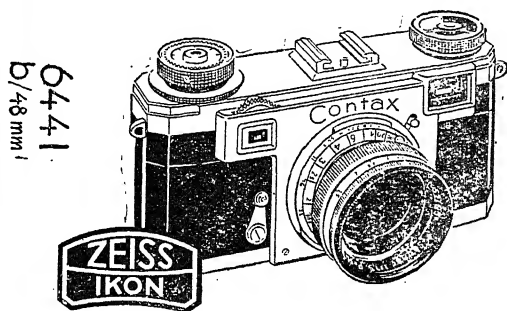
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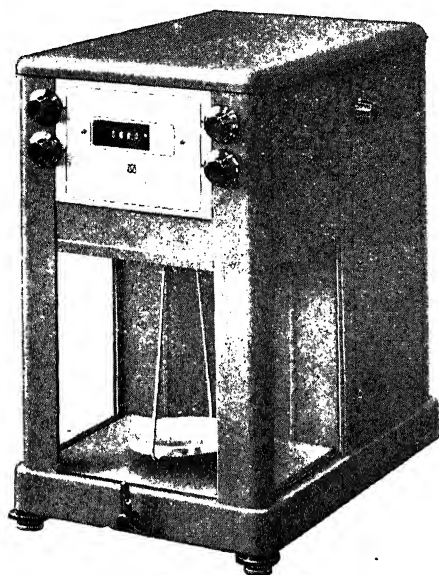
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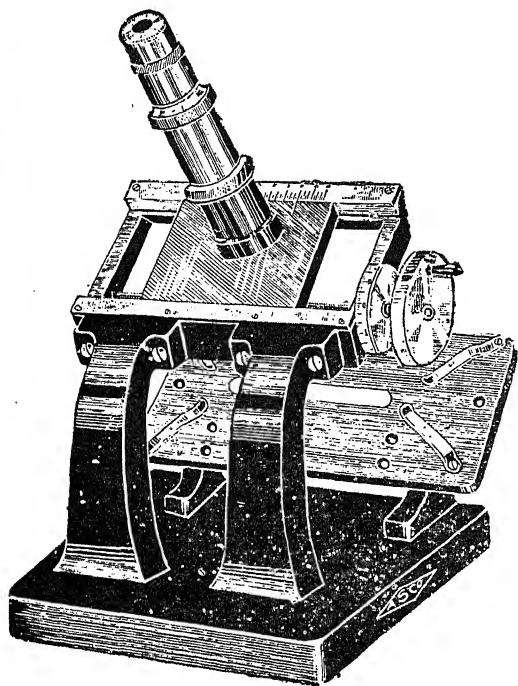
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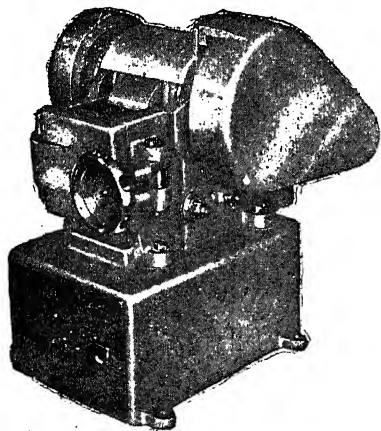
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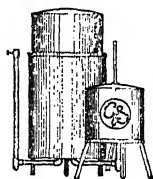
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Current Science

Vol. XIX]

AUGUST 1950

[No. 8

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SCIENTIFIC SUPPLIES STORES AND THE GOVERNMENT

I HAVE read with much interest and with a certain amount of justifiable irritation also, your leading article in the June issue of your valuable journal. As one engaged in the scientific trade for nearly 25 years and, having more than mere commercial interest in the progress of science in India, I wish to place before your readers certain facts of which apparently they and many scientific workers in India are totally ignorant and which have a very direct bearing on the difficulties which you have pointed out in your article. You have mentioned that you have to pay $2\frac{1}{2}$ to 5 times in India, which is obviously a generalisation from isolated experiences and therefore wrong. I have drawn the attention of the concerned trade associations to this charge and it is expected they will deal with it suitably. As regards your suggestion that Government should run its own stores, it is for the scientists and the public to say, if the displacement of several hundreds of traders in this line is in national interest, if the Government has the mentality and organization to run such stores, if this would eventually be cheaper, and if the scientist would like to forego the many services and technical assistance which he receives from the trade. It is not my purpose to deal with these matters in greater detail.

As regards shortages of which you complain, for those of us who are in this trade, our existence has been a non-stop and heart-breaking struggle against red-tape and almost total lack of appreciation of the day-to-day needs of the scientist, the vastly increased need for equipment due to expansion in industry and education, and the realities of the situation. It is very unfortunate that the scientists have no idea whatsoever of how import and allied controls work and how these restrictions are primarily responsible for the situation which they are facing today. For the past 18 months, we have not received any import licences for imports from W. Germany, which had become a prompt and valuable source of supply of much needed instruments at reasonable prices. Applications submitted during January-June 1949 period are still undisposed of, and we must take it for granted that they are to be considered as "finished". The Open General Licence No. XI which helped us to get goods from U.K. and sterling area was cancelled over a year ago and since that even imports from the sterling area have been at standstill, either because no licence was issued or because the licence issued was so small and limited to a very few items. Some U.S.A. licences have been issued, and on account of the depreciation of

the Rupee by nearly 50 per cent., scientists were not prepared to buy U.S.A. goods. It will be readily seen why one cannot get scientific goods in India. Our shelves are getting rapidly empty and we have no means of replacing the sold goods. Application for licences for January-June 1950 are still pending in Delhi and, I think, every scientist should remember these facts, when he finds that he cannot get on with his work. As stated in the article, scientists have been "helplessly and patiently tolerating" all this all these years; they should have shouted against all the needless restrictions. Any noise created by the trade, from time to time, was looked upon with apathy and aloofness by the scientists themselves.

The tale of "Swadeshi" in scientific instruments and appliances has been a sad one and the less said of it, the better. The urge and the initiative to produce things in India, were left to a set of inadequately organised and small concerns, with practically no help and sympathy from the scientist. How often do we get the instructions "Indian goods are not wanted" and how can the trade be blamed for the situation created? You must ask the glass manufacturer, why India cannot produce really good laboratory glassware and he will give you a catalogue of grievances which will stagger you. He has no materials for making or re-making his furnace, he has no raw-materials and chemicals of the proper quality, he has no wagon to bring the raw-materials, labour is difficult to get and very expensive and, above all, he has no money, and no scientific backing. He produces glass in his own way and you refuse to use it.

In addition to these major difficulties, there are several minor troubles, which have a far-reaching influence on your work in the laboratory. You must know how import quotas and restrictions actually work. Take chemicals for example. During the January-June licensing period, the quota for chemicals (Reagent quality) was $6\frac{1}{4}$ per cent. of past imports for 6 months. Not much imagination and ingenuity are needed to visualise the implications of this $6\frac{1}{4}$ per cent. There is another side to it. We, for example, do not handle general chemicals, but stock only certain microscopic reagents, such as stains, of which our annual imports will be not more than two or three thousand rupees. $6\frac{1}{4}$ per cent. of this will work out to Rs. 187 worth goods for 6 months. Unfortunately we cannot get a licence for Rs. 187 because the minimum licence issued is only for Rs. 250. So

we go without even this pittance and all the small importers are pushed out like this and the scientist gets furious when he cannot get his stains, his peptone, his xylo, etc. So much for quotas and let us examine some total embargos. Paraffin-wax which is used in large quantities in all biological and medical laboratories was completely prohibited upto July 1950 and I know that good quality wax is not available for any laboratory today. Electric bulbs, such as the ones you use in your colorimeters, projection instruments, are completely prohibited from all sources except soft currency area for which the quota is 5 per cent. for 6 months! If you have any U.S.A., German or Swiss instrument requiring a spare bulb, God help you. Similarly if you want a set of spare batteries for your Beckman pH Meter, you are asking for the man in the moon, because these batteries are taboo, from U.S.A. Do you know that porcelain dishes, crucibles, etc., are totally forbidden, because these are in the same category as commercial porcelainware? Do you know that Laboratory Reagent Bottles and Jars, of which there is a terrible scarcity, are also forbidden?

After having gone through all the hurdles and after all the waiting, we get a licence and then we have the customs to contend with. When dealing with the import control section, one gets the impression that the restrictions are more to obstruct trade than to regulate it and after getting a licence and when goods arrive, one gets the impression that customs is on the look-out for flaws in the licence and a consequent infringement of regulations. Goods change their characteristics with surprising rapidity. A pH Meter is a scientific instrument today under Tariff 77 (2) and tomorrow it becomes an appliance or an electrical instrument, under different sections. If therefore your licence does not cover the latter sections, you have put your foot into troubles. They have even argued that an Industrial pH Meter is not a scientific instrument because even an untrained man in the factory can use it, while the Laboratory model pH Meter is scientific because only a scientist can handle it! There are several instances like this making the importer's position totally unbearable. Do you know that we cannot import silica dishes, crucibles, etc., because they have no place in the tariff for themselves and are classified as "Others" and totally prohibited? So if you cannot get paraffin-wax, stains, spare bulbs, batteries, porcelain-ware, silica-ware, glassware in general, the blame is not ours.

I would like your readers to try and understand the position, and the complexities of it. Many of these restrictions are needless and all scientific equipment should be allowed to come in freely. That will solve short-supply and will bring down the prices also. I understand that Government of India is going to exempt all scientific goods from Customs duty and this will be like putting the cart before the horse. The demand for equipment is really great and our own quotas will not be enough to meet the demand. Very often we are helped by the customer getting his own licences and even here the formalities involved, in operating on the licences, are formidable and heart-breaking. In whatever direction you turn, you knock against some hard impediment and I have often wondered, whether there is any use in continuing this struggle and, in trying to help our customers amidst all this. Nearly half of our daily correspondence is about goods which we do not have and cannot have.

As I write this, we hear of another World War and are breathlessly waiting for something to happen. In 1939, when the war broke out, India had plenty of stocks of everything, plenty of goods were coming from U.S.A., U.K. and Japan for nearly 3 years and our needs were not much. If another war should overtake us now, we must remember we have nothing to go on with and will not get anything for a very long time. Even if another war is

not imminent, anyone can see that U.S.A. and the whole of Europe is being rearmed and it is obvious that goods for civilian use will become scarcer and scarcer. If scientists can get their voice heard in responsible quarters, I would suggest that you ask for complete relaxation of all restrictions on scientific, medical and surgical equipment, so that we can get something when the going is good.

Added at the proof stage :—

"Since writing, the Government of India has placed 'Scientific and Surgical' instruments under Open General Licence from all countries upto end of December 1950. As usual there is a snag even here. Optical instruments have been omitted and the result is that we cannot get microscopes and accessories, magnifiers, etc., which are in terrible short-supply. It is inconceivable why this discrimination is made and the only sensible explanation is that the authorities could think only of spectacle lenses and frames as 'optical' and wanted to shut them out. The tussle with the customs authorities will now get sharper, as scientific instruments will become 'appliances' rendering the important illegal and exposing the importer to penalties which in the case of soft currency is 100 per cent. and hard currency, complete confiscation of goods."

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ISI REPORT ON WEIGHTS AND MEASURES

THE special committee on weights and measures set up by the Indian Standards Institution last year to recommend ways and means for terminating the existing wasteful diversity, finds a solution in the adoption of the metric system. The report of the special committee, which is unanimous, is now complete and has just been issued by the Indian Standards Institution in a special publication.

Based on a countrywide consensus of opinion of scientists, technologists, industrialists and Government departments, the Committee's recommendation for the adoption of the metric system envisages a change-over in three stages extended over a period of about 15 years. A preparatory stage of three to five years for intensive dissemination of information on the new system, would be followed by a change-over stage of about the same period and a final stage for over-all transition. After that period, the only system accorded legal recognition would be the metric system.

In regard to the nomenclature of the new system, the report records the view that the international nomenclature should be used, unless Parliament decides to have an Indianised system. In the latter contingency, however, it has been advised to avoid the use of the existing names, such as seer and guz for kilogram and meter.

Before presenting the recommendations of the Committee, the Report traces the historical background of the movement for standardisation of weights and measures since 1801. A brief summary of the proceedings of the Committee at its three sessions and the views of various organisations elicited in reply to a questionnaire issued by the Committee in the early stages of its deliberation, are also included in an appendix.

Copies of the Report, which is priced at Rs. 2 each, may be had from the Secretary (Administration), Indian Standards Institution, 19 University Road, Civil Lines, Delhi.

ON A LARGE SAMPLE METHOD OF ESTIMATING UNEMPLOYMENT IN LARGE CITIES

J. C. KOOP

(Directorate of Labour, Rangoon, Burma)

SUPPOSE we have a large city which possesses a certain number of employment exchanges serving different parts of it. If each exchange registers all unemployed persons, then the total number unemployed in the city would be completely known. However, as they do not always seek the assistance of exchanges, the numbers registered by exchanges do not represent all the unemployed. Now, how may this information be used, as supplementary information, to estimate the total number unemployed? Since the problem is also closely linked with the estimation of the proportion of persons unemployed, and, of that number, the proportion using the exchanges, they may as well be discussed together.

Assume that a plan of the city showing natural boundaries (streets, lanes, walls, etc.) is available. It may be divided up along natural boundaries into very small areas (grids, in Mahalanobis' terminology) for the following reasons:

(1) Small size grids are more convenient to handle than large ones.

(2) The sampling theory will require the number of grids to be as large as possible. Hence the sizes of grids should be as small as possible.

Suppose the total area of the city has been divided up into N grids without paying careful attention to the numbers included in each grid. At the moment of time, to which the survey refers, let z_i be the total number of persons inhabiting the i th grid, y_i the number unemployed in the same grid and of this number let x_i be the number who have registered themselves as unemployed at an exchange; ($i=1, 2, \dots, N$). Experience shows that the number unemployed is generally more in poor than in relatively well-to-do localities, and also persons in indigent circumstances depend more on the services of exchanges than persons in more favourable circumstances. Hence we may assume that x , y and z are mutually independent. Let σ_x^2 , σ_y^2 and σ_z^2 be the variances of x , y and z respectively. $X = \sum_{i=1}^N x_i$, which is known exactly, is the total number of unemployed persons on the books of exchanges. $Y = \sum_{i=1}^N y_i$ will

be the total number of unemployed persons in the city. $Z = \sum_{i=1}^N z_i$ will be the population of

the city, and generally, this figure cannot be expected to be known with precision except if an up-to-date and accurate census figure is available. Assuming that no person enters or leaves the city, at the period of time when the survey is conducted, X , Y and Z will be fixed numbers. (Obviously $X < Y < Z$). We are attempting to estimate Y and the ratios $\frac{X}{Y}$ and $\frac{Y}{Z}$.

It will be shown that the estimating equations of these statistics involve ratios and on this account it will not be possible to obtain accurate and exact expressions for their standard errors. However, it is possible to obtain their confidence limits by an application of a theorem, first stated by Fieller (1940), to the special case for large samples in the way described below.

Let n grids be chosen at random, each grid being assigned an equal probability of selection. Let the quantities x , y and z , as defined above, be observed in each grid. Then

$$\bar{x} = \sum_{i=1}^n x_i/n, \bar{y} = \sum_{i=1}^n y_i/n \text{ and } \bar{z} = \sum_{i=1}^n z_i/n$$

will be unbiased estimates of the average number of registrations for employment, of the number unemployed, and of the number inhabiting each grid respectively. Consider the function

$$d = \bar{x} - \frac{X}{Y} \bar{y}. \quad (1)$$

Its expectation can be shown to be zero, i.e., $E(d) = 0$, so that an estimate Y' of Y or $\left(\frac{X}{Y}\right)'$

of $\frac{X}{Y}$ can be obtained by putting $d=0$ in (1) and this yields two estimating equations

$$Y' = \frac{\bar{y}}{\bar{x}} X \text{ and } \left(\frac{X}{Y'}\right)' = \frac{\bar{x}}{\bar{y}} \quad (2),$$

which are ratio estimates, which one could have obtained intuitively. The variance of d , $V(d)$, can be shown to be

$$V(d) = \left(\frac{\sigma_x^2}{n} + \frac{X^2}{Y^2} \frac{\sigma_y^2}{n} \right) \cdot \frac{N-n}{N-1}$$

assuming that x and y are independent. When N is infinite, or for all practical purposes when it is effectively large, then

$$V(d) = \frac{1}{n} \left(\sigma_x^2 + \frac{X^2}{Y^2} \sigma_y^2 \right). \quad (3)$$

Further in large-scale sampling (i.e., when $n > 150$), \bar{x} and \bar{y} will be almost normally distributed, so that for all practical purposes d will be normally distributed with zero mean and standard deviation $\sqrt{V(d)}$. Hence, under the conditions stated above,

$$u = \left(\bar{x} - \frac{X}{Y} \bar{y} \right) / \left\{ \frac{1}{n} \left(\sigma_x^2 + \frac{X^2}{Y^2} \sigma_y^2 \right) \right\}^{\frac{1}{2}} \quad (4)$$

will be distributed normally with zero mean and unit variance. It follows that if we wish to obtain confidence limits of Y , or $\frac{X}{Y}$ corresponding to the confidence level $\frac{p}{100}$, we need

only to substitute the appropriate normal deviate for u corresponding to the $p\%$ significance level, and solve the above quadratic equation for Y , or $\frac{X}{Y}$ as the case may be. When rearranged as a quadratic in Y , (4) appears as $Y^2 \left(\bar{x}^2 - \frac{u^2 \sigma_x^2}{n} - 2\bar{x}\bar{y}XY + X^2 \left(\bar{y}^2 - \frac{u^2 \sigma_y^2}{n} \right) \right) = 0$ (5), the roots of which are

$$X(n\bar{x}\bar{y} \pm u\sqrt{n(\bar{x}^2\sigma_y^2 + \bar{y}^2\sigma_x^2) - u^2\sigma_x^2\sigma_y^2}) / (n\bar{x}^2 - u^2\sigma_x^2) \quad (6)$$

the root with the positive sign before u giving the upper confidence limit and that with the negative sign before u giving the lower confidence limit of Y . Similarly the upper and lower confidence limits of $\frac{X}{Y}$ may be obtained

by the solution of equation (5), treating $\frac{X}{Y}$ as the unknown.

The same arguments apply for the estimation of $\frac{Y}{Z}$. Its estimate would be $\frac{\bar{y}}{\bar{z}}$, and, its confidence limits could be obtained in a similar manner as for $\frac{X}{Y}$. If Z is accurately known, a

second estimate of Y , which would be $\frac{\bar{y}}{\bar{z}} Z$ could serve as an independent check on the first. However, too much reliance cannot be placed on this estimate, except if Z is a recent census figure. For, if Z is in error by ΔZ , then the estimate of Y will also be in error by $\frac{\bar{y}}{\bar{z}} \Delta Z$. It is precisely for this reason that the estimation of Y is recommended by the method first described rather than by this method.

The confidence limits discussed above presuppose that σ_x^2 , σ_y^2 and σ_z^2 are known. In prac-

tice, they are not at all likely to be known. However, in large samples, their estimates may be substituted without serious danger of error or loss in accuracy. Also, it may be possible to control σ_x^2 , but it will not be possible to control σ_x^2 and σ_y^2 , since for any system of fixed grids, the number of unemployed cannot be expected to remain constant in each grid and therefore x and y will be varying throughout time. If every grid contained the same number of persons then $\sigma_x^2 = 0$; however, this cannot be realised in practice. But it may be possible to demarcate the grids so that they hold approximately the same number of persons, if some prior knowledge about the distribution of houses or population is available. Under such circumstances, σ_x^2 would assume a lower value than if grids had been demarcated otherwise.

The above suggestion has a bearing on the question of obtaining the shortest possible confidence intervals, under the conditions stated, given of course the confidence coefficient. An inspection of (6) will show that the length of the confidence interval of Y is

$$2uX \sqrt{n(\bar{x}^2\sigma_y^2 + \bar{y}^2\sigma_x^2) - u^2\sigma_x^2\sigma_y^2} / (n\bar{x}^2 - u^2\sigma_x^2)$$

and the only way to narrow it down (and for that matter, also that of $\frac{X}{Y}$) would be

by increasing the sample size. For the confidence interval of $\frac{Y}{Z}$, the width of the interval is

$$2u \sqrt{n(\bar{z}^2\sigma_y^2 + \bar{y}^2\sigma_z^2) - u^2\sigma_y^2\sigma_z^2} / (n\bar{z}^2 - u^2\sigma_z^2)$$

and, it is clear from this formula, that the narrowness of width, besides depending on n , depends also on how low the value of σ_z^2 is, and therefore, it may be narrowed down further by demarcating the grids in the way already suggested.

To sum up, ratio estimates have been suggested for three unemployment statistics, namely, (a) the total number unemployed, (b) the proportion using employment exchanges, (c) the proportion in the city unemployed, the first named depending on supplementary information for its estimation. Their confidence limits have also been derived on the basis of large sample theory, and on the assumption that the number of grids is very large. For the statistic representing the proportion unemployed, a method of reducing the width of its confidence interval is proposed.

A PAPYROGRAPHIC STUDY OF THE NONPROTEIN NITROGEN OF MANGOES (*MANGIFERA INDICA* LINN.)

V. S. GOVINDARAJAN AND M. SREENIVASAYA

(Section of Fermentation Technology, Indian Institute of Science, Bangalore-3)

PARTITION chromatography on filter paper, 'Papyrography'^{1,2} offers an elegant, simple and rapid method for a study of the content of free amino acids and simple peptides in mixtures and in extracts. Dent, Stepka and Steward³ pioneered the use of this method to the study of plant tissue extracts. Joslyn and Stepka⁴ recently reported what is perhaps the only study of free amino acids in some fruit

pulps. We have carried out a papyrographic study of the non-protein nitrogen fraction of the four common varieties of mango (*Mangifera indica*).

The rind free pulp of the four varieties of mangoes, Malgova, Raspuri, Alfonso and the ungrafted country variety, was extracted with acidulated alcohol (final alcoholic concentration in the mince reaching 80 per cent. by

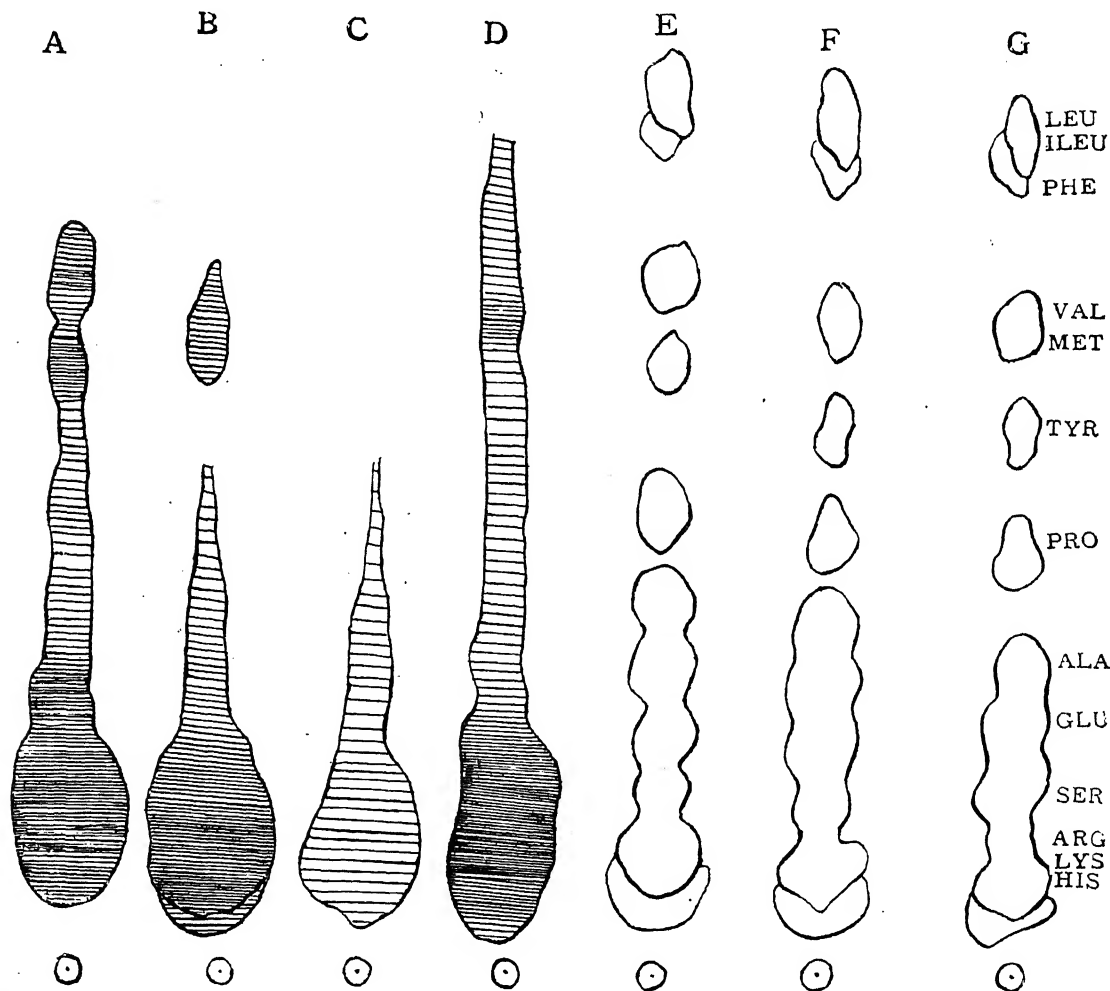


FIG. 1

A—D: Chromatograms of alcoholic extracts of four varieties of mangoes. A: Ungrafted variety; B: Raspuri; C: Alfonso; D: Malgova. Note:—Relative intensities of colour of spots indicated by shading. Names of amino acids abbreviated according to Brand and Edsall, *Ann. Rev. Biochem.*, 1947, **16**, 223. FIG. 1 E Chromatogram of a sample of Casein hydrolysate (acid). FIG. 1 F: Chromatogram of Casein hydrolysate (acid) with 10 per cent. glucose. FIG. 1 G: Chromatogram of Casein hydrolysate (acid) with 20 per cent. glucose.

volume), in a Waring blender.⁴ The extracts were concentrated to a syrup in a desiccator under vacuum over concentrated sulphuric acid. It was taken up with 1/5 the volume of water, which leaves most of the carotenoid pigments undissolved. The aqueous solution was extracted with ether to remove traces of the remaining pigments. The total nitrogen-content of these extracts was determined by direct Nesslerisation after digestion and equalized.

The concentrated extracts were chromatographed in one dimension at a level of 10×10^{-3} ml. by the ascending technique and with *n*-butanol-acetic acid as the developing solvent, as described earlier.⁵ Ordinary diet jars with ground glass plate covers and Whatmann No. 1 paper 20 cm. \times 20 cm. were used so that the four samples and reference mixtures could be chromatographed simultaneously.

Obvious conclusions from the chromatograms (see Fig. 1) are, (1) that the order of richness of ninhydrin-positive substances is: Mulgova, Raspuri, ungrafted variety, Alfonso being least; (2) that except for some weak spots which reveal the presence of some of the usual amino acids, all the extracts yield a continuous, big, pear-shaped and characteristic spot below the position usually occupied by glutamic acid. Though Joslyn and Stepka report that "peptides do not, as a rule, occur in detectable amounts in the cold alcohol extracts of plant tissues", it is not possible to explain such a heavy concentration of ninhydrin-positive substances (see Fig 1) except by assuming the presence of peptides.

The extracts contain high percentages of reducing sugars (up to 20 per cent.) which, it was thought, might interfere with the chromatographic picture. Casein hydrolysates enriched with 10 and 20 per cent. of glucose were prepared and chromatographed simultaneously with sugar-free casein-hydrolysate. In presence of the sugar, a slight decrease of the R_f values was observed, but the general clarity of the picture, the relative positions of the amino acids and their separation were not affected. The reducing sugar was then removed as the osazone and after removal of the excess of phenylhydrazine from the mother-liquor by extraction with ether, the casein-hydrolysate was chromatographed. This step did not result in any detectable alteration in the picture, showing thereby, that the presence of sugar does not materially affect the separations.

With a view to elucidate the nature of the peptides suspected to be associated with the extracts, the samples were hydrolysed in a

sealed tube with 6N HCl at 100° C. for 24 hours. The removal of the acid from, and the concentration of, the hydrolysates were simultaneously effected by placing the hydrolysates in flat-bottomed dish in a thin layer in an evacuated desiccator containing solid sodium hydroxide and concentrated sulphuric acid in different dishes. The operation was usually repeated three times to remove most of the acid. The syrupy residue was reconstituted to the original volume with water and aliquots used for

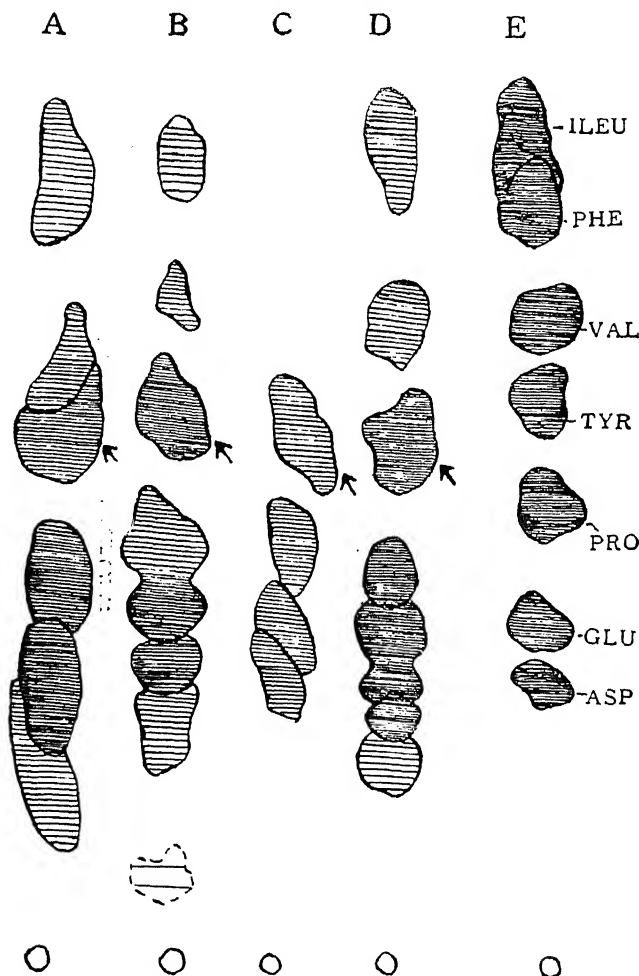


FIG. 2

Chromatograms of hydrolysed extracts of A: Ungrafted variety; B: Raspuri; C: Alfonso; D: Malgova; E: Reference mixture of pure amino acids. Note: Arrow indicates position of the amino acid referred to in text as 'near-tyrosine spot.' Relative intensities of colour spots indicated by shading. Names of amino acids abbreviated according to Brand and Edsall (*loc-cit.*).

chromatographing, on an equal nitrogen basis. The results are represented in Fig. 2.

At 50×10^{-3} ml. level of the original extract the chromatogram reveals that Mulgova extract shows the maximum number and concentration of amino acids followed closely by the ungrafted country variety and the grafted Raspuri variety. The Alfonso variety shows, surprisingly, the least number and concentration of amino acids.

A careful scanning of the chromatograms leads to the following conclusions:—(1) *Mulgova*: Aspartic acid, glutamic acid, alanine, serine or glycine are the principal amino acids with basic amino acids, valine or methionine and leucines occurring in smaller amounts. Also prominent was another spot (indicated by an arrow in Fig. 2) near that of tyrosine having a characteristic bright bluish purple colour and hence different from tyrosine which gives the dull purple colour. This is the position reported for γ -amino-butyric acid in a single dimensional chromatogram with butanol-acetic acid solvent.⁶ γ -Amino-butyric acid has been reported to be a constituent of many plant tissues.^{3,4} Its absolute identity, however, has yet to be established in mango extracts.

(2) *Country variety*: Aspartic and glutamic acids and the near-tyrosine spot are the principal components with glycine, alanine, valine

or methionine and leucines as minor constituents.

(3) *Raspuri*: Aspartic and glutamic acids, alanine and the near-tyrosine spot are the principal amino acids and glycine or the basic amino acids, valine or methionine are in smaller amounts. The presence of cystine and leucine group is indicated.

(4) *Alfonso*: Aspartic and glutamic acids and near-tyrosine spot are the chief constituents though the amounts are smaller than that of other varieties. Basic amino acids and alanine are seen in smaller amounts. The picture given by the unhydrolysed extract of this variety, showed the pear-shaped spot which was weak and dull.

The identification of the near-tyrosine spot and an analysis at higher levels by double chromatogram is in progress.

Our thanks are due to the Director, Indian Institute of Science, for his kind interest and the Council of Scientific and Industrial Research, India, for financial help.

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GOVERNMENT TO PURCHASE URANIUM STOCKS

UNDER Section 3 (d) of the Atomic Energy Act, XXIX of 1948, uranium is a 'prescribed' substance and cannot, therefore, be exported. The Government of India have decided to purchase all stocks of uranium available with dealers or mine-owners. The purchase of acceptable uranium-bearing minerals and ores or concentrates will be on the following price basis:

- (1) A minimum uranium content equivalent to 10 per cent. by weight of uranium oxide in the ores or concentrates will normally be required.
- (2) The price to be paid will be based upon the uranium content of the ores or concentrates and will be at the minimum rate of Rs. 9 per pound of contained uranium oxide f.o.r. station of despatch, and this price will be guaranteed for a period of five years commencing from the date of announcement.
- (3) This price will include all radioactive elements in the ores or concentrates but consideration will be given to the

commercially recoverable value of any associated non-radioactive constituents in the ores such as cerium groups of earths, columbium, niobium, etc., either by adjustment of prices or by re-delivery of the residues containing such constituents.

- (4) All purchase of uranium will be subject to the provisions of the Atomic Energy Act XXIX of 1948.

Rules regarding detailed procedure to be followed for the sampling of uranium and despatch of consignments of uranium to the Chairman, Atomic Energy Commission, Bombay, may be obtained from the Secretary, Atomic Energy Commission, Department of Scientific Research, New Delhi.

Under the Atomic Energy Act XXIX of 1948, uranium being a 'prescribed' mineral can be compulsorily acquired by the Government. It would, therefore, be advantageous for dealers and mine-owners or persons possessing stocks of uranium to sell their stocks to the Government of India at an early date.

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PRACTICAL NUMBERS

THIS is a sequel to an earlier note on Practical Numbers published two years ago in *Current Science*.¹ A positive integer N is said to be 'practical' or more briefly a P-number, if every positive integer less than N admits of partition into unequal parts all of which are factors of N . The general structure of such a number is set forth here and it includes all the special types noticed before.

Notation: N_i denotes $2^{a_0} p_1^{a_1} p_2^{a_2} \dots p_i^{a_i}$ ($p_0 = 2 < p_1 < p_2 < \dots < p_i$) and σ_i the sum of all the factors of N_i , where the a 's are positive integers and the p 's primes.

Lemma: If N_i is a P-number and any positive integer not exceeding σ_i can be partitioned

into unequal divisors of N_i , then these properties hold good for N_{i+1} , if $p_{i+1} \leq 1 + \sigma_i$.

Since $\sigma_{i+1} = \sigma_i (1 + p_{i+1} + p_{i+1}^2 + \dots)$, the interval $(\sigma_i, \sigma_{i+1})^*$ can be subdivided, in order from left to right, into intervals of lengths $I_1, I_2, \dots, I_{a_{i+1}}$, where $I_k = \sigma_i p_{i+1}^{1-k+a_{i+1}}$, ($k \leq a_{i+1}$).

Now any positive integer x ($\sigma_i < x \leq \sigma_{i+1}$) is bound to fall in one of these sub-intervals, say k -th, i.e. $x = I_1 + I_2 + \dots + I_{k-1} + R_k$, where

$$0 < R_k \leq I_k. \quad (1)$$

When $R_k = I_k$, the required partition is obvious. It is sufficient to consider the case $R_k < I_k$. Dividing R_k by $p_{i+1}^{1-k+a_{i+1}}$, so that A is the quotient and B is the remainder and expressing B in scale p_{i+1} , we may write

$$R_k = Ap_{i+1}^{1-k+1a_{i+1}} + B_0p_{i+1}^{-k+a_{i+1}} + B_1p_{i+1}^{-k-1+a_{i+1}} + \dots + B_{-k+a_{i+1}}, \quad (2)$$

where $A < \sigma_i$ since $R_k < I_k$, and the B 's are all less than p_{i+1} and do not exceed σ_i by virtue of the condition provided.

Now A and all the B 's can, by hypothesis, be partitioned into unequal divisors of N_i . Substituting the known partitions for A , B 's and I 's in (1) and (2), we get a partition for x into unequal divisors of N_{i+1} . If $x \leq \sigma_i$, it can be partitioned into unequal factors of N_i i.e., of N_{i+1} also. Thus the lemma is proved.†

Theorem 1. 2^{a_0} (or N_0) is a P-number such that every positive integer not exceeding the sum of the divisors of 2^{a_0} can be expressed as the sum of distinct divisors of 2^{a_0} , a_0 being any positive integer.

To prove the theorem we have only to remember that

$$\sigma_0 \text{ (i.e., the sum of the divisors of } 2^{a_0}) \\ = 1 + 2 + 2^2 + \dots + 2^{a_0} = 2^{1+a_0} - 1,$$

and express any positive integer less than $1 + \sigma_0$ in the binary scale to effect the required partition.

Theorem 2. If Np^a (p an odd prime) be a P-number, then $p \leq 1 + \sigma(N)$.

If $p > 1 + \sigma(N)$ then $1 + \sigma(N)$ cannot evidently be expressed as the sum of distinct divisors of N , nor can any of the parts in any partition of $1 + \sigma(N)$ involve p . This contradicts the implications of the hypothesis. Therefore $p \leq 1 + \sigma(N)$.

Combining the above theorems and the lemma we establish, by induction, the structure of a P-number in the form of

Theorem 3. The necessary and sufficient condition that N_i is a P-number are

$$p_i \leq 1 + \sigma_{i-1}, \quad (i = 1, 2, \dots)$$

with the more or less obvious corollaries, viz.,

1. Every P-number N_i possesses the property that any number not exceeding σ_i can be partitioned into unequal divisors of N .

2. The product (as well as the L.C.M.) of any number of P-numbers is a P-number.

3. Any non-P-number can be converted into a P-number by multiplying it by a suitable power of 2. (Hence, any rational proper fraction can always be expressed as the sum of unit-fractions.)

4. If N_i is a P-number, the number formed by increasing one (or more) of the indices of the primes in N_i by any positive integer is also a P-number.

5. If x be any positive integer such that any positive integer less than x can be expressed as the sum of distinct divisors of another positive integer y , then $x-1$ is less than the sum of the divisors of the greatest P-number contained in y .

The following two conjectures may be hazarded from Tables A and B given below.

(i) The r -th P-number is less than the r -th odd prime.

(ii) The number of P-numbers less than x exceeds the number of primes less than x .

TABLES
A

x	100	200	300	400	500	600	700	800	900	1000
Number of P-numbers less than x	28	48	68	90	108	127	144	161	178	198
x	25	46	62	78	95	109	125	139	154	168
Number of primes less than x	25	46	62	78	95	109	125	139	154	168

B

P-numbers greater than 200 and less than 1001

204, 208, 210, 216, 220, 224, 228, 234, 240, 252, 256, 260, 264, 270, 272, 276, 280, 288, 294, 300, 304, 306, 308, 312, 320, 324, 330, 336, 340, 342, 348, 352, 360, 364, 368, 378, 380, 384, 390, 392, 396, 400, 408, 414, 416, 420, 432, 440, 448, 450, 456, 460, 462, 464, 468, 476, 480, 486, 496, 500, 504, 510, 512, 520, 522, 528, 532, 540, 544, 546, 552, 558, 560, 570, 576, 580, 588, 594, 600, 608, 612, 616, 620, 624, 630, 640, 644, 648, 660, 666, 672, 680, 684, 690, 696, 700, 702, 704, 714, 720, 726, 728, 736, 740, 744, 756, 760, 768, 780, 784, 792, 798, 800, 810, 812, 816, 820, 828, 832, 840, 858, 860, 864, 868, 870, 880, 882, 888, 896, 900, 912, 918, 920, 924, 928, 930, 936, 952, 956, 960, 966, 968, 972, 980, 984, 990, 992, 1000.
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Mysore, A. A. KRISHNASWAMI AYYANGAR.
May 28, 1950.

* All intervals are taken to be open on the left and closed on the right.

† The lemma and its proof are the outcome of my consulting Prof. T. Vijayaraghavan.

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VELOCITY DISTRIBUTION LAW AND THE DIAMETER OF THE PARTICLES OF A GAS

CONSIDERING the collision processes occurring in a gas, it has been shown that the total change in momentum, in one direction, suffered by all the particles lying in a unit area perpendicular to that direction, per second, is given by $\frac{16}{\pi^2} m n^{5/3} \sigma^2 b^{-1}$, where m is the mass,

n is the number per unit volume and σ is the diameter of the particles and b is the constant occurring in the velocity distribution law $dn_u = nae^{-bu^2} du$. This rate of change of momentum is the pressure $p = nkT$. Hence b comes out to be $\frac{16mn^{2/3}\sigma^2}{\pi^2kT}$. The value of

b , equal to $\frac{m}{2kT}$, which is usually derived on the assumption of dimensionless particles, and which incidentally holds good in case of actual gases, vapours and assembly of particles in equilibrium, is seen to be a particular case, when $\sigma = (0.555)n^{-1/3}$. Thus, at N.T.P., n being equal to 2.7×10^{19} per c.c., σ should be equal to 1.85×10^{-7} cm. This is of the same order as the diameter of gaseous particles determined by practical methods.

Full details will appear elsewhere.

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June 4, 1950.

ELLIPTIC POLARISATION OF LIGHT SCATTERED BY PERSPEX GLASS

In the course of a detailed investigation of the structure of glass, certain interesting results were obtained with perspex glass (methyl methacrylate). The observations were made using a rectangular block, $3'' \times 3'' \times 1''$ in dimensions, kindly supplied by the Imperial Chemical Industries Ltd. Light from a powerful carbon arc was focussed on the block and the state of polarisation and ellipticity of light scattered transversely were measured by the usual experimental technique. Table I gives the percentage of depolarisation, ρ_u , ρ_v and ρ_h and $\Delta\rho_h$ calculated using Krishnan's reciprocity relationship, for perspex and for a standard glass block obtained by the same experimental set-up.

TABLE I

	$\rho_u\%$	$\rho_v\%$	$\rho_h\%$		$\Delta\rho_h\%$
			Observed	Calculated	
Perspex	2.22	0.88	61.5	61.9	0.52
Glass	25.36	12.04	75.92	73.17	3.91

For measurements of ellipticity of polarisation of scattered light, the method adopted by

Krishnan and Rao¹ for glass was employed. The incident light was polarised by a nicol and the transversely scattered light was passed through an analysing nicol placed in crossed position with reference to the plane of polarisation of the incident light and then analysed by a calibrated Babinet compensator. As the polarising nicol was rotated from the vertical to the horizontal, the visibility of the fringes of the compensator and the intensity of the pattern gradually diminished. For perspex, the visibility was a minimum at a position nearly 3° from horizontal. Even before this position was reached, i.e., at about 20° from the horizontal, the fringe system began to shift laterally with respect to the cross-wires originally set on the central dark band. This shift continued to increase gradually as the rotation of the polariser was continued. When the polariser was horizontal, the cross-wires appeared on the bright band. These observations show that the scattered light is a mixture of unpolarised and elliptically polarised light. The shift was measured for different settings of the polariser, which gives a measure of ellipticity. Table II gives the results obtained along with those for the standard glass block used for comparison.

TABLE II

Substance	Angle θ from horizontal	Phase shift in terms of π	Range of θ in which shift is observed
Perspex	0	1	20°
	5	0.63	..
	10	0.24	..
	15	0.04	..
	20	0.	..
Glass	0	1	38°
	10	0.42	..
	20	0.11	..
	30	0.02	..
	40	0.	..

These observations for perspex glass are similar to those made by Krishnan and Rao² for inorganic glasses and show that the light scattered by perspex is elliptically polarised. According to Mie's theory, it follows that like the inorganic glasses, perspex glass consists of molecular clusters of size comparable to the wavelength of light. The last column in Table I gives $\Delta\rho_u$, which is the difference between the observed value of ρ_u and the anisotropic part given by $2\rho_v/(1+\rho_v)$. The low value of $\Delta\rho_u$ shows that the clusters are not however so large as in most of the inorganic

glasses. It may also be mentioned that while this work was in progress, a note on the scattering of light in plastics was published by Mr. Nambiyar,³ while the values of ρ_u , ρ_v and ρ_h obtained by him are different from those given here, $\Delta\rho_u$ is nearly the same.

My thanks are due to Prof. C. S. Venkateswaran for his guidance and interest in the work.

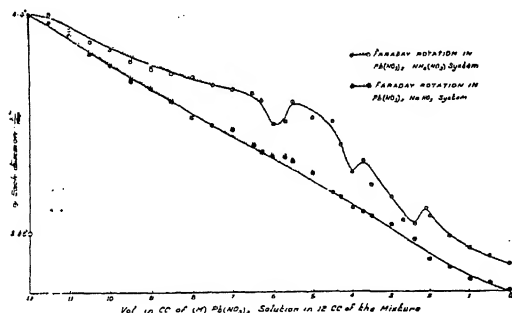
(MRS.) ALEYAMMA GEORGE.

Physics Department,
University College,
Trivandrum,
June 10, 1950.

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FORMATION OF COMPLEX COMPOUNDS BETWEEN LEAD NITRATE AND ALKALI NITRATES

MEASUREMENTS of the Faraday rotation and its variation with composition of a mixture of molar solutions of $\text{Pb}(\text{NO}_3)_2$ and KNO_3 carried out by the writer¹ recently confirmed the existence of complex compounds at specified concentrations as postulated by Nayar and Pande.² The investigation has now been extended to the case of mixtures of molar solutions of lead nitrate as one component and ammonium nitrate or sodium nitrate as the second component.



The accompanying figure represents the variations of Faraday rotation for λ 5461 with composition of the mixture for the two cases. The curve for the system $\text{Pb}(\text{NO}_3)_2 + \text{NH}_4\text{NO}_3 + \text{H}_2\text{O}$ exhibits a marked departure from that for a regular mixture. It has three pronounced minima corresponding to the relative concentrations of lead nitrate and ammonium nitrate in the ratio of 1:1, 1:2 and 1:4 respectively. The curve representing the varia-

tions of Faraday rotation with concentration for the system $\text{Pb}(\text{NO}_3)_2 + \text{NaNO}_3 + \text{H}_2\text{O}$ does not show any such anomaly. This suggests that while complex compounds are formed in $\text{Pb}(\text{NO}_3)_2 + \text{NH}_4\text{NO}_3 + \text{H}_2\text{O}$ system at the three specific concentrations mentioned above, they appear to be absent in the system $\text{Pb}(\text{NO}_3)_2 + \text{NaNO}_3 + \text{H}_2\text{O}$. In this respect, the behaviour of the system containing lead nitrate-ammonium nitrate is similar to that of the system containing lead nitrate-potassium nitrate. The results reported here fully confirm the conclusions arrived at by Nayar and Pande² regarding the formation of complex compounds between lead nitrate and alkali nitrates.

The author is grateful to Professor R. S. Krishnan for suggesting the problem.

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June 26, 1950.

1. B. K. Narasimhamurthy, *Proc. Ind. Acad. Sci.*, 1950, **31**, 160. 2. Nayar and Pande, *Ibid.*, 1948, **27**, 285, 349; 1949, **30**, 25.

ULTRASONIC VELOCITY IN ORGANIC SOLUTIONS

THE author has studied the variation of ultrasonic velocity and adiabatic compressibility in the solutions of benzoic acid in different organic solvents at different concentrations and various temperatures employing Debye and Sears' method of diffraction of light by high-frequency sound waves.

Parthasarathy,¹ Ram Pershad² and Wilson and Richards³ have reported some observations on supersonic velocities and compressibilities of liquid mixtures and also discussed their relationship with the chemical constitution. But a solid solute does not appear to have been used in the mixture. The author, therefore, thought it worthwhile to study the solutions of benzoic acid in different organic solvents with a view to find whether the laws which hold for liquid mixtures also hold for mixtures of solid in liquids.

The following results have been obtained:—

1. The velocity in a pure solvent is always greater than that in the solution.
2. The presence of a solid constituent, however small it may be, always lowers the velocity.
3. The velocity in a solution increases with dilution.

4. The adiabatic compressibility of a solution increases with concentration.

5. The velocity decreases with increase in temperature.

In conclusion, the author expresses his sincere thanks to Dr. D. B. Deodhar and Dr. P. N. Sharma for guidance and encouragement.

Physics Department, K. C. LAL.
Lucknow University,
Lucknow,
June 14, 1950.

1. Parathasarathy, *Proc. Ind. Acad. Sci.*, 1936, **3A**, 297.
2. Ram Pershad, *Ind. Jour. Phys.*, 1941, **15**, 323; *ibid.*, 1942, **16**, 1, 307. 3. Wilson and Richards, *Jour. Phys. Chem.*, 1932, **36**, 1268.

FLUORESCENCE OF CRYSTALLINE MAGNESIUM OXIDE

Light scattered by a transparent specimen of MgO crystal has been photographed, using a Littrow type quartz spectrograph. The specimen has the approximate dimensions of 0.8" × 0.8" × 0.7". No Raman lines have been recorded either in the visible or in the ultra-violet region. Two fluorescent bands, which are fairly intense, with their mean wavelengths at λ 6812 and λ 6994 A.U. are found to occur. One of these bands is about 20 Angstroms broad and the other is sharp. Fluorescent bands in this region have previously been recorded in Al_2O_3 . Crystals like diamond show similar effects, but in other regions of the spectrum. A second order Raman scattering of moderate intensity may be expected in this substance according to recent findings of Burstein and Smith* but our present work indicates that such an effect, if present, is quite weak.

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Osmania University, P. G. PURANIK.
Hyderabad (Deccan),
July 15, 1950.

* *Proc. Ind. Acad. Sci.*, 1948, **28**, 377.

EFFECT OF UREA, URIC ACID, BARBITURIC ACID AND ALLOXAN ON THE BIOSYNTHESIS OF RIBOFLAVIN IN ANIMALS

FOODSTUFFS contain, in addition to protein, some non-protein nitrogenous compounds as amides, glucosides, etc., and it was of interest to study whether these compounds may be

utilised by rats for the biosynthesis of riboflavin assisted by intestinal microflora.

A group of six adult rats was first fed for a week on a riboflavin-free basal diet composed of 80 gm. starch, 7 gm. sucrose, 6 gm. groundnut oil, 5 gm. salt mixture (Osborne and Mendel) and 2 gm. codliver oil and with daily vitamin supplements of 20 μ g thiamine, 300 μ g nicotine acid, 25 μ g pyridoxine, 500 μ g pantothenate, 10 μ g biotin and 1,000 μ g choline for each rat-urine and feces being collected for a further period of three days. The diet was then supplemented with 0.1 gm. urea (this being the simplest amide was first selected) and the excretions on this supplement were collected in the above way. The riboflavin estimation was made by the method of Slater and Morell.¹

It is found from the table below that urea supplement produces a large increase in the riboflavin excretion.

Table showing the effect of feeding urea, uric acid, barbituric acid and alloxan on the riboflavin excretion in rats. The figures represent the average values in μ g per rat per day

Diet and supplement	Fecal output	Urinary output
Basal diet	7.3	4.4
„ +0.1 gm. Urea	17.9	7.2
„ +0.1 gm. Barbituric acid	7.1	4.8
„ +0.1 gm. Alloxan	7.5	4.0
„ +0.1 gm. Uric acid	4.2	3.4

Attention was then directed to study the possible intermediates through which the above conversion of urea to riboflavin takes place in the intestine.

In the laboratory riboflavin is synthesised from alloxan^{2,3} and barbituric acid⁴ which can also be prepared directly from urea. These compounds were, therefore, used to test whether they serve as intermediates in the above process. The results in the table show that they do not.

Uric acid, which is an intermediate compound between urea and barbituric acid and alloxan, has also been tried, but in this case a notable depression of the riboflavin excretion was observed. This may be due to the inhibiting action of the uric acid or some of its products on the growth of the riboflavin-synthesising microflora by their interference with the uracil, thymine or other purine derivatives.

which act as essential metabolites for the above bacterial species.

Biochem. & Nutri. Labs.,
Dacca University,
Dacca, Pakistan,
April 6, 1950.

H. N. DE.
J. K. ROY.

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INCREASED YIELDS OF RAGI THROUGH ZINC SALT FERTILIZATION

THE need for small amounts of zinc for growth and development of the higher plants has been reported by various workers.^{1,2} While considerable evidence exists that zinc is required by many fruit plants for their normal growth, its deficiency being recognized by distinctive symptoms, little information exists of its requirements by cereals or of deficiency symptoms in them. In particular, little is definitely known of the requirements of our staple food crops for this and other trace elements for optimum crop production.

(R.0009 variety) with the different treatments are given below. The soil of the experimental plot is a reddish brown sandy loam typical of soils of Bangalore District. The manurial treatment to all the plots was uniform with a basal dressing of farmyard manure at 2 cart-loads per acre and groundnut oilcake at 3 cwt. per acre. Zinc and copper were applied as sulphate at 5 lbs. to the acre while boron was applied as borax at 20 lb. level, these salts being applied mixed with the groundnut cake, at the time of application. The layout was 7 × 7 latin square, and the individual plot size was 1/120th acre.

The results indicate that application of 5 lb. zinc sulphate has increased the total crop by about 23 per cent. over control, while the individual yields of dry grain and straw are increased in each case by 12 per cent. Based upon these findings large-scale trials to obtain increased yields of ragi using zinc sulphate mixed with the usual manures, are in progress.

Chemical Section, H. G. GOPALA RAO.
Agric. Res. Institute, S. V. GOVINDARAJAN.
Bangalore,
April 15, 1950.

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Treatment	Fresh weight—Total crop		Dry weight—Grain		Dry weight—Straw	
	lb. per acre	% Variation over control	lb. per acre	% Variation over control	lb. per acre	% Variation over control
Boron	6068.6	+ 2.62	977.1	-17.54	1920.0	-13.85
Copper	6822.9	+15.37	1148.5	0.0	2400.0	+ 7.69
Zinc	7302.9	+23.49	1285.7	+11.94	2502.3	+12.31
Boron + Copper	6308.6	+ 6.67	1251.7	+ 8.98	2091.4	- 6.15
Zinc + Copper	6737.1	+13.92	1097.1	- 4.47	2091.4	- 6.15
Zinc + Boron	6240.0	+ 5.51	1114.2	- 2.99	2160.0	- 3.07
Control	5914.0	0.00	1148.5	0.00	2228.5	0.00

In the course of our studies on the content and availability of the essential trace elements in Mysore soils, the response of our cereal crops to the application of various trace elements is being investigated. Field experiments at the Government Central Farm, Hebbal and elsewhere, indicate that ragi (*Eleusine coracana*) responds markedly to applications of zinc sulphate, and this communication is intended as a preliminary note to record our observations.

The results of field trials at the Hebbal Farm during 1949 monsoon season on ragi

DEHYDRATION OF CASTOR OIL BY SUBSTITUTED SULPHONIC ACIDS AS CATALYSTS

DEHYDRATION of castor oil is also found to be brought about by using sulphonic acids and their salts in place of sulphuric acid as catalysts. (1) Benzene sulphonic acid, (2) toluene sulphonic acid, (3) *m*-sulpho benzoic acid and (4) *pot*. phenol sulphate are found to be good catalysts, while sodium salts of *p*-xylene sulphonic acid, anthraquinone 2-6-sulphonic acid, 1-naphthol-5-sulphonic acid, 1-naphthylamine-2-sulphonic acid and a few others of this group are

not so effective. It appears that the dissolution or decomposition of the salt at the temperatures employed (250-80° C.) is a prerequisite for its activity.

The dehydrated oil is generally pale in colour, low in viscosity and in acetyl value--often as low as 18. Refractive indices vary between 1.4788-1.4826. Molecular weights determined by Cryoscopic method in benzene are between 840-860. Under appropriate working conditions, the quality of this oil may improve further. The results of a few experiments are given below.

Catalyst %	Temperature °C.	Time min.	Iodine value	Remarks
1 1.0	220	60	120	Dehydration very quick
2 2.0	250	..	130	Pale reddish brown oil
3 1.0	"	"	130	Dehydration is quicker
0.5	"	"	123	than with sulphuric acid,
0.3	"	"	132	catalyst is reactive even in
0.2	"	"	120	low concentration of 0.1%.
0.1	"	"	117	Oil is pale coloured
4 2.0	275	100	129	
1.75	"	60	127	CO ₂ passed during de-
1.0	280	100	130	hydration. Oil is very
"	"	60	116	pale in colour and of low
				viscosity

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May 5, 1950.

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V. R. KESKAR.

ESTIMATION OF PEROXIDES IN GHEE BY THE FERRIC THIOCYANATE METHOD

INDIAN workers interested in storage study of ghee have been using a method (Lea¹) of iodometric determination of peroxide to measure the extent of oxidative spoilage. Depending possibly on the peculiar make-up of the glycerides susceptible to oxidation and/or on the type and quantity of the natural anti-oxidants present, Patel and Ray^{2,3} have shown significantly variable peroxide values by Lea's method in different ghee samples at the first organoleptically detectable point of spoilage. In some cases the values were large enough for easy determination, in others the values were low and could only be determined with difficulty,

Recently, in connection with an investigation on the standardisation of the methods of manufacture of ghee, we have observed that in ghee samples prepared under certain experimental conditions, peroxide development (as determined by Lea's method) on storage was extremely slow, so that even when the oxidative spoilage was quite perceptible from loss of aroma and deterioration in flavour, the estimated peroxide values varied between 0.2 to 0.7 only. We tried to verify this anomaly by checking up each stage of Lea's technique as well as the reagents used, but failed to get a satisfactory explanation. As an alternative, we attempted the ferric thiocyanate method of peroxide determination which Hills and Thiel⁴ claim to be sufficiently sensitive to measure the peroxides of fat in milk and milk products at quite an early stage of its oxidation. The method applied by us on ghee was essentially the one developed by Hills and Thiel (*loc. cit.*) with a few variations, such as, (a) adoption of standard iron solution itself instead of the artificial standard of a cresol-red solution previously calibrated against the former, and (b) use of an alternative fat solvent, chloroform-ethanol (7:3) which Hills and Thiel have found quite as suitable as benzene-methanol (7:3) used in their investigation.

TABLE I

Determination of peroxide value in ghee
by the ferric thiocyanate method

Sample	Weight of sample (g.)	Peroxide value*	Mean	% Deviation from the mean
A	.. 0.220 0.250	3.20 3.00	3.10	±3.2
B	.. 0.126 0.130	4.62 4.71	4.67	±0.9
C	.. 0.111 0.114	5.26 4.94	5.10	±3.1
D	.. 0.116 0.097	5.22 5.76	5.49	±4.9
E	.. 0.106 0.100	6.10 6.22	6.16	±1.0
F	.. 0.100 0.130	7.07 6.74	6.90	±2.5
G	.. 0.115 0.115	8.12 8.33	8.23	±1.3
H	.. 0.073 0.073	10.50 10.35	10.43	±0.7
I	.. 0.103 0.100	11.14 11.49	11.32	±1.6
J	.. 0.107 0.120	14.15 13.49	13.82	±2.4

* Peroxide value expressed as milliequivalent of oxygen per kilogram of fat.

A fairly large number of trials have been carried out and it is observed that (a) the ferric thiocyanate method is capable of yielding reproducible values; the data of a typical trial set out in Table I show that the average deviation from the mean of the duplicate determinations lies within ± 2.2 per cent., and (b) the method is definitely more sensitive than Lea's as would be evident from the data given in Table II on the progressive peroxide estimations in samples of stored ghee.

TABLE II

Peroxide value in ghee determined by ferric thiocyanate and Lea's methods

Cow ghee		Buffalo ghee	
Ferric thio- cyanate	Lea's	Ferric thio- cyanate	Lea's
I	5.50	nil	11.40
	9.63	"	28.76
	11.50	0.20	34.95
II	5.80	nil	10.83
	9.75	"	25.83
	11.82	"	35.45
	13.20	0.20	..

Since peroxide development in fat can be greatly accelerated by the aeration of the test substance maintained at an elevated temperature, the method in conjunction with above technique should be able to gauge the keeping quality of newly made ghee samples obtained under variable conditions of production.

The detailed study will be reported in the *Indian Journal of Dairy Science*.

Indian Dairy Research Institute, P. DEVI.
Bangalore, S. C. RAY.
April 27, 1950.

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Thiel, C. C., *J. Dairy Res.*, 1946, **14**, 340.

METHIONINE AND CYSTINE CON- TENTS OF THE COMMON PIGEON EGG

THE eggs for this investigation were obtained from birds in captivity, fed, in general, on cereals.

The methods for the estimation of total sulphur,² methionine,³ and of cystine⁴ are those which have been followed earlier.¹ The egg white was separated from the yolk by the method of Plimmer and Rosedale.⁵ The results

of the present investigation are given in the following table.

	Total Sulphur %	Cystine Sulphur %	Methionine Sulphur %
Egg white ..	1.3990	1.0460	0.3311
	1.3970	1.0510	0.3312
Mean ..	1.3980	1.0485	0.3312
Egg yolk ..	1.1527	0.8012	0.3400
(freed from fat)	1.1542	0.8065	0.3398
Mean ..	1.1535	0.8039	0.3399
Egg yolk, calculated on the basis that the fat was <i>not</i> removed	0.8215	0.5723	0.2420
Total, for whole egg if the fat is <i>not</i> re- moved	2.2195	1.6208	0.5732

The sulphur contents of the eggs of hen, guinea fowl, and of pigeon compare as follows.

	Total Sulphur %	Cystine Sulphur %	Methionine Sulphur %
Hen ⁶	1.5000	0.6351	0.8588
Guinea Fowl ¹	3.9575	1.8996	0.7478
Pigeon (Present work)	2.2195	1.6208	0.5732

Rajaram College,
Kolhapur,
May 25, 1950.

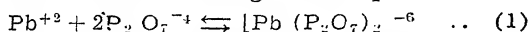
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PYROPHOSPHATO COMPLEX OF LEAD IN SOLUTION

THE marked increase in the solubility of lead pyrophosphate in alkali pyrophosphate solutions suggests complex formation in solution. Thermometric, conductometric and pH-titrations of alkali pyrophosphate solutions with lead nitrate solutions indicate the existence of complex ion of the type pyrophosphate : lead equal to 2 : 1 within the concentration range (0.01-0.2M) studied. Transport measurement shows the presence of lead ion in the anode

liquid and thus eliminates the formulæ $[\text{Pb}(\text{H}_2\text{P}_2\text{O}_7)_2]^{+2}$ and $\text{Pb}(\text{H}_3\text{P}_2\text{O}_7)_3$ for the complex ion. The conductivity of the alkali pyrophosphate solution either remains constant or rises very slowly with the addition of lead nitrate solution up to the point pyrophosphate: lead equal to 2:1. This observation excludes the possibility of the ions $[\text{H}_2\text{P}_2\text{O}_7]^{-2}$ and $[\text{HP}_2\text{O}_7]^{-3}$ acting as co-ordinating unit in the complex ion. Thus it is concluded that the complex ion is of the formula $[\text{Pb}(\text{P}_2\text{O}_7)_2]^{-6}$ and is formed according to the equation



The instability constant of the complex ion has been found out from conductivity measurements by Job's method of continued variation.¹ It is as follows:

Let solutions of lead nitrate and sodium pyrophosphate of concentrations C and $P \times C$ moles per litre respectively are mixed in varying proportions. Let the mixtures be made by the addition of x litres of pyrophosphates to $(1-x)$ litres of lead nitrate ($x < 1$) with no appreciable volume change on mixing. Let C_1 , C_2 and C_3 be the concentrations of lead ion, pyrophosphate ion and the complex ion $[\text{Pb}(\text{P}_2\text{O}_7)_2]^{-6}$ respectively. For any mixture the following equations apply

$$C_1 = C(1-x) - C_3 \quad \dots (2)$$

$$C_2 = PCx - 2C_3 \quad \dots (3)$$

$$C_1 \times C_2^2 = KC_3 \quad \dots (4)$$

when C_3 is maximum

$$dC_3/dx = 0 \quad \dots (5)$$

Differentiation of equations (2), (3) and (4) and combination of the three resulting differential equations with equations (2) to (5) gives $C^2P[(P+2)x-2]^3 = K[2-3x][P-1]^2$ (6) Hence from a knowledge of the maximum composition x for non-equimolecular solutions, which can be obtained from experimental curves and from the known values of C and P, K, the instability constant of the complex ion is determined with the help of the equation (6). The mean value of K is found to be 4.744×10^{-6} at $35^\circ \pm 0.1^\circ \text{C}$.

My best thanks are due to Prof. P. B. Sarkar, Calcutta University, for his kind interest and helpful suggestions.

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June 7, 1950.

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ANTIMALARIAL ACTIVITY OF AUREOMYCIN IN BLOOD INDUCED INFECTION IN CHICKS

ANTIMALARIAL activity of aureomycin in *P. gallinaceum* infection in chicks has been reported by G. R. Coatney, *et al.*¹ During routine testing of antimalarial drugs in this laboratory, we were interested in the antimalarial activity obtained with aureomycin. The following series of experiments were carried out to confirm the above finding and also to evaluate the efficacy of the drug in preventing relapse of a primary blood-induced infection in chicks.

The strain of *P. gallinaceum* was maintained in stock birds.² Blood from donor bird showing 30 to 40 per cent. parasitaemia was taken by cardiac puncture in 2 per cent. citrate solution. About 0.2 c.c. of the diluted citrate solution containing 16×10^6 parasitized erythrocytes was injected to the pectoral muscle of white leg-horn chicks of average weight of 60 gm. Drug was administered twice daily, starting 4 to 5 hours before inoculation and continued for four days. Blood films from the treated as well as from the control birds were examined from the fifth day after inoculation. Aureomycin was given orally, dissolved in water. The results are given in Table I.

TABLE I
Antimalarial activity of Aureomycin in Chicks
infected with *P. gallinaceum*

Experiment No.	Drug dose mg./100 g. body weight of chick for 4 days b.i.d.	Parasites per 500 r.b.c.							Remarks
		Days after inoculation							
		5	7	9	11	15	20		
1	7.5	0	0	3.5	25	..	..	Died after 15 days
2	15	0	0	0	60	65	..	Died after 20 days	
3	10	0	0	0	0	0	25	Treatment repeated for 3 days from the 8th day of injection. Birds died after 25 days	
4	Control	1	50	175	..	..	..	Died before 10th day

It was observed that at a dose of 7.5 mg. there was a reduction in parasitaemia and at 15 mg. the suppressive effect was pronounced by the late appearance of parasites in the peripheral blood. In experiment 3, the drug was repeated again for three days from 8th day onwards. It is usually found that there is a recrudescence on or about the 10th day after preliminary suppression treatment, depending upon

the condition of the bird. It was observed that with the repetition of the drug on the 8th day, the parasitic relapse was delayed till the 20th day and all the birds lived up to 25 days after infection.

Aureomycin acted as a preventive and therapeutically active drug against chick malaria. It was also found to be quite effective in the prevention of relapse in blood induced infection of *P. gallinaceum* in chicks.

Our thanks are due to the President, American Cynamid Co., New York, and to the authorities of Lederle Laboratories, New York, for kindly supplying aureomycin. We are grateful to Dr. K. P. Menon for his valuable suggestions during the course of the work.

Pharmacology Lab., A. S. RAMASWAMY.
Indian Inst. of Sci., R. RAMA RAO.
Bangalore 3, N. K. KESHAVAMURTHY.
July 30, 1950. N. N. DE.

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TIP PULP OF THE MANGO FRUIT

INSTANCES where the tip of the mango fruit (*Mangifera indica* Linn.), becomes prematurely pulpy and turns dark brown have been found in the United Provinces, where the disease is very common and a loss of 25 per cent. of the total crop is estimated. The disease is commonly found on fruits nearing maturity. The varieties affected were *Safeda*, *Maldaha*, *Bambai* and *Lucknow*.

The first visible symptom was the yellowing at the tip, turning greyish later on. The tip was pulpy (although the rest of the fruit was compact, unripe and hard) and slightly sweet but far different from the usual taste of the ripe fruit. The affected fruits do not ripen through storage, and mean a complete loss to the growers.

Preparations of the pulp, made under aseptic conditions, showed complete absence of any fungal or bacterial organisms. The cells of the mesocarp in the diseased pulp showed dis-jointed cells, and the compactness of the tissues was effectually loosened. The cells lining the ducts, developed a kind of dark brown deposit. Also, the size of the cells was smaller and their contents rather shrivelled up and generally pushed to one side.

The affected pulp was cultured on various bacteriological and fungal nutritive media,

both for aerobic and unaerobic organisms, and incubated at 30° C. No growth was visible; showing that no organism was responsible for the causation of this disease.

Healthy mangoes of the *Safeda* variety were inoculated with the diseased pulp after the method described by Murphy and Kay. All the fruits remained healthy, no tip-pulp appeared. This again confirms the results of the previous experiments that no bacteria or fungi are responsible for the disease.

As far as the author is aware this is a new record of the disease.

The author is indebted to Dr. S. N. Das Gupta for his helpful criticism and guidance.

Department of Botany, G. S. VERMA,
Lucknow University,
January 16, 1950.

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THE ASSOCIATION OF SIZE AND COLOUR IN GRAM (*CICER ARIETINUM* L.)

ALL seeds of bengal gram having a genetic constitution Bp were small and round compared to other genotypes where B was absent or P was present in the crosses.¹ This association was further verified in the segregating

TABLE I

Name of type in accession list	Seed colour grade	Genic constitution	Mean weight in milligrams per seed segregates in					
			Pure	T8 × T11	T10 × T13	T11 × 493	T8 × T13	T12 × T11
R1	CS1	bP & bp	.. 146	..	..	..	..	..
T8	2	bP & bp	127	156	..	..	101	..
T10	3	bP & bp	107	182	164	..	137	..
R4	4	bP & bp	.. 152	..	..	..	142	..
R5	5	Bp	.. 83	..	..	..	50	..
R6	6	Bp	.. 90	..	..	..	56	..
T11	7	Tp	70	79	.. 75	..	72	66
T13			70	..	73	..	61	66
R8	8	BP	.. 170	..	..	..	150	..
R9	9	BP	.. 168	..	..	..	129	..
493	10	Bp	133	..	.. 165	..	..	..
T12			147	169	167	..	151	172
R11	11	BP	.. 165	..	..	..	145	..

N.B.—The prefix R under accession denotes re-combination type,

populations of crosses effected with T11 and T13 varieties of gram² possessing round small seeds weighing 70 milligrams per seed or thereabouts. The genic constitutions of the parents and recombination types together with their mean seed weights are given in the table.

Columns 4 to 10 show clearly that all factorial compositions of Bp conforming to CS 5, 6 and 7 are small seeded while others having bp, bP and BP are big seeded. This behaviour persists even in the third generation.

Other workers³ have drawn attention to the smallness of seeds in the bluish brown CS7 grade, although the actual weights were not given. Linkages between colour factor and quantitative factors like yield, grain size or row number have been recorded on other crops.^{4,5,6,7} As there was no single instance of crossover in all the crosses studied by the author, it should be concluded that factor B had pleiotropic effects on petal colour, seed coat colour and size, and that the depressing effect on size was unaffected by factors other than P.

Agricultural College R. BALASUBRAHMANYAN.
and Research Institute,
Coimbatore,
March 28, 1950.

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TUBERCULINA SP. PARASITIC ON PUCCINIA BUTLERI

WHILE collecting material for *Puccinia butleri* Syd. for morphological and cytological studies, widespread occurrence of an urediniculous fungus was noticed. *Puccinia butleri* incites systemic infection of *Launœa asplenifolia* DC., the pycnia and æcia developing on vertically growing shoots. The hyperparasitic fungus, found to be a species of *Tuberculina*, was chiefly confined to the pycnia and æcia of *P. butleri*.

Under field conditions, *Tuberculina* was found to be a severe parasite, completely suppressing the æciospore development in *P. butleri*. In many cases, the æcial primordia were invaded by the hyperparasite, resulting in their disorganisation. The dense pinkish sporodo-

chia of *Tuberculina*, composed of compactly grouped conidiophores and conidia, imparted a pinkish-violet tinge to the entire hypertrophied shoot, bearing the æcia.

The conidiophores measure $24-40 \times 1.5-3.5 \mu$. The conidia are acrogenous, subglobose to spherical, pale pinkish in colour, measuring $6-10 \times 6-12 \mu$. The conidia germinated readily under favourable moisture conditions, develop long, septate and uninucleate germ tubes. While most of the *Tuberculina* infections were confined to the mature sori and plectenchymata of the rust, cases of individual spores being parasitised by the germinating conidia have also been noticed.

An account of the identity of the *Tuberculina* species, under study, is being published separately.

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April 4, 1950.

R. C. LACY.

EFFECT OF β -INDOL-3-ACETIC ACID, PHENOXY ACETIC ACID AND β -NAPHTHOXY ACETIC ACID ON GROWTH OF *ALTERNARIA TENUIS*

WORK on the effect of growth regulators on filamentous fungi has been attempted by several authors, the latest and the most comprehensive being that of Rebekah Ruth Richards.¹ Earlier, Murdia² had tried the effect of β -indol-3-acetic acid and phenyl acetic acid on growth of some Saprolegniaceæ and found them to be having no stimulating effect. Wolf³ tested the effect of α -naphthalene acetic acid on *Achlya bisexualis* and *Saprolegnia ferax* and he also got negative results. Rebekah noted a maximum stimulation of 22 per cent. in growth, working with varying concentrations of 4 growth regulators on 4 filamentous fungi. Work along these lines has however been rather limited and as far as known to us that of Murdia is the only one attempted in India.

With a view to find the effect of vitamins and hormones on the growth of plants, we made experiments with *Alternaria tenuis* to start with. It was isolated from *Pandanus fascicularis*⁴ and is an easily culturable fungus. In this note it is intended to give the preliminary observations while a detailed paper will be published later on.

With slight modifications, the technique given by Rebekah was adopted for carrying on these experiments. The growth regulators tried were β -indol-3-acetic acid, phenoxy acetic acid and

β -naphthoxy acetic acid obtained from Eastman Kodak Company. The fungus was grown on synthetic medium. The solution of the growth regulators was made in 50 per cent. acetone. The concentrations used were 0.1 per cent., 0.05 per cent., 0.01 per cent., 0.001 per cent. and 0.0001 per cent. The medium containing 1 per cent. of the solvent served as control. In each of the required number of tubes, 20 c.c. of medium was poured and autoclaved. The different concentrations were added after sterilisation to avoid hydrolysis. 0.2 c.c. of the required concentration was added to each tube so that it formed 1 per cent. of the medium. These were stirred well and poured into sterilised petridishes measuring 80×12 mm.

A standard spore suspension was prepared by suspending spores of cultures 20-day old in sterilised water and one drop each of it was spread on triplicate sets of petridishes by a sterilised dropper.

A latent period of 24 hours was necessary for the germination of spores. The diameter of the colony was measured along 4 directions after the onset of growth at regular intervals. The percentage stimulation or inhibition was calculated on the basis of controls both at early and late stages of growth. Cultures were maintained at $28-30^\circ\text{C}$.

The observations are represented in the following graphs (Figs. 1 and 2):—

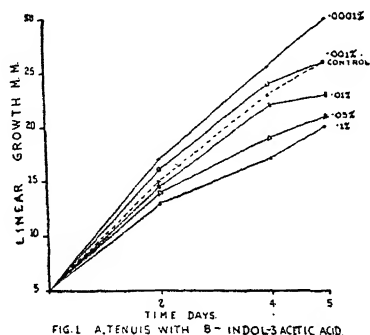


FIG. 1. *A. TENUIS* WITH β -INDOL-3-ACETIC ACID

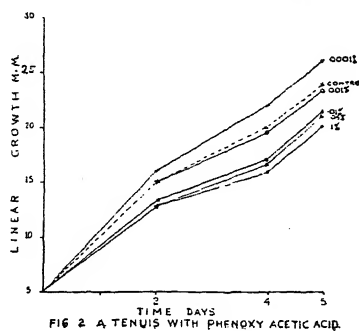


FIG. 2. *A. TENUIS* WITH PHENOXY ACETIC ACID

From these results it will be seen that with β -indol-3-acetic acid, inhibition in growth occurs at higher concentrations of 0.1 per cent., 0.05 per cent. and 0.01 per cent. while there is stimulation in growth at 0.001 per cent. and 0.0001 per cent. In case of phenoxy acetic acid, growth is inhibited at concentrations 0.1 per cent., 0.05 per cent. and 0.01 per cent., is almost unaffected at 0.001 per cent., and stimulated at the lowest concentration of 0.0001 per cent.

β -Naphthoxy acetic acid had inhibitory effect upto 0.001 per cent. while the lowest concentration of 0.0001 per cent. was without any effect.

The morphological nature of the cultures did not undergo much change except that the pigmentation was a bit lighter.

Thanks are due to the U.P. Scientific Research Committee for financing this work.

Department of Botany, H. P. CHOWDHURY.
Lucknow University, M. KAMAL.
May 10, 1950.

1. *Bot. Gaz.*, June 1949, 110. 2. *Curr. Sci.*, 1939, 8, 362-63.
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A NEW VIRUS DISEASE OF *DOLICHOS LABLAB*

A VIRUS disease of *Dolichos lablab* L., exhibiting broad bright yellow patches, was first observed in July 1940 at Poona. It has later been noticed in several other localities including the worst affected tracts of Gujrat, Khandesh and Deccan.

Transmission tests under insect-proof conditions show that the virus is readily transmitted by the white-fly, *Bemisia tabaci* Gen., but is neither transmitted by sap-inoculation nor through the seed. Transmission tests with other insects, viz., *Aphis medicaginis* K., *Empoasca devastans* Dist., *Coptosoma cribraria* F., *Episomus lacerta* F., commonly found breeding on *D. lablab*, carried out by employing healthy glass-house grown seedlings gave negative results. These insects collected from healthy or diseased plants were invariably fed on diseased plants for 4 to 12 hours before liberating them on the healthy test plants, on which they were allowed to feed for 12 to 24 hours. The results (Table I) show that only the white-fly is capable of transmitting the virus.

The symptoms of the disease appear in about 14 to 20 days following inoculation in the form of faintly discoloured patches on leaf laminae. These patches develop into a bright yellow,

which spreads leaving only a few spots and stripes of green tissue. There is neither malformation nor reduction in leaf size, nor dwarfing of affected plants which grow well and appear to bear with significant reduction in yield.

TABLE I
Transmission tests with the *Dolichos* yellow mosaic virus

Transmission by	Plants inoculated	Plants diseased
Sap inoculation	24	0
<i>Aphis medicaginis</i>	6	0
<i>Empoasca devastans</i>	6	0
<i>Coptosoma cribraria</i>	4	0
<i>Epismus lacerta</i>	3	0
<i>Bemisia tabaci</i>	54	48



Fig. 1. A leaf of diseased *Dolichos lablab*

A virus disease of double bean, *Phaseolus lunatus* L., producing similar symptoms and transmitted in nature also by *Bemisia tabaci* has been previously reported.¹ However in several transmission tests in which 34 double bean plants were inoculated, the infective white-flies failed to transmit the *D. lablab* virus to any of the double bean plants. Also the yellow mosaic of *Phaseolus lunatus* is unable to infect *D. lablab*.¹ Yet another virus, the enation mosaic of *Dolichos lablab*,² which is sap transmissible and has not yet been transmitted by any insect vector, causes a disease in *Dolichos lablab* the symptoms of which are entirely different from those caused by the virus dealt with in this note.² Thus the disease in *Dolichos lablab*, although resembling yellow mosaic of double bean¹ in its symptoms, is

entirely different, and it is proposed to name it as 'Yellow mosaic of *Dolichos lablab*'.

Out of 12 plants of a variety of *Dolichos lablab* observed to be immune to the yellow mosaic virus under field conditions, only one became infected, when 20 to 30 infective white-flies were made to feed on plants that had been raised in an insect-free glass-house. Twelve plants of a susceptible variety, similarly inoculated, became diseased. The above-mentioned resistant variety seems to be fully resistant to the virus when grown in randomised blocks in the field. The seeds of this variety were kindly supplied by the Dy. Director of Agriculture (Crop Research), Poona.

This work is being carried out under a Scheme financed by the Indian Council of Agricultural Research.

Plant Pathological Lab.,
College of Agriculture,
Poona,
May 14, 1950.

S. P. CAPOOR.
P. M. VARMA.

1. Capoor, S. P., and Varma, P. M., *Curr. Sci.*, 1948, 17, 152. 2. — *ibid.*, 1948, 17, 57.

PARTHENOGENETIC DEVELOPMENT OF THE EGG IN *SPIRANTHES* *AUSTRALIS* LINDL.

A STUDY of the preparations made in 1943 from the material of a terrestrial orchid *Spiranthes australis* from Dacca, East Bengal, supplemented by further preparations made this year from the material collected from Nepal, revealed the following features.

Microsporogenesis occurs as usual, the pollen grains remain united in tetrads, and each grain is bicelled at maturity.

The embryo-sac is of the Polygonum type and arises from the chalazal megaspore of the tetrad. However, due to a failure of the last division at the chalazal end, it contains only 6 nuclei organised to form an egg, two synergids, two polar nuclei and a single antipodal cell. The pollen tube enters through the micropyle. One of the male gametes fuses with the egg. The other may remain unused; and even if triple fusion occurs, the primary endosperm nucleus disintegrates without undergoing further divisions. The development of the embryo shows no special peculiarities except that there is no well-marked suspensor and the ovoid undifferentiated embryo is enclosed within the seed-coat formed only by the outer integument. An observation worthy of record is

that sometimes the egg may develop without fertilisation. Evidences in support of such parthenogenetic development of egg are given below:

1. In some embryo-sacs the pollen tube had not opened while the egg had already begun to divide.

2. In other embryo-sacs, although the pollen tube had discharged its contents, the male nuclei remained unused and formation of the proembryo had already begun.

3. Two-celled proembryos with the undischarged pollen tube lying beside the proembryo were also seen sometimes.

4. An embryo had developed in one embryo-sac, which had apparently not received a pollen tube at all and in which the synergids were still intact.

5. Chromosome counts during the first division of egg showed the haploid number (± 15) in parthenogenetic eggs and diploid number (± 30) in the fertilised eggs.

6. Division stages in proembryos confirmed the occurrence of parthenogenesis. Embryos in fertilised embryo-sacs showed the diploid number of chromosomes.

It is interesting to note that haploid embryos have also been recorded by Hagerup (1944, 1945, 1947) in some other orchids, viz., *Orchis*, *Listera* and *Cephalanthera*. Careful studies may reveal their occurrence in other members of the family.

Rarely two pollen tubes were found in an embryo-sac and in one case six male nuclei were seen around the egg. This indicates the possibility of polyspermic fertilisation and the origin of polyploid embryos.

S. australis seems to differ markedly from *S. cernua* recently investigated by Swamy (1948). In *S. cernua* Swamy collected three distinct races. In the first or sexual race, syngamy takes place normally and a single embryo is produced in every seed. In the second or agamospermic race, the pollen is sterile and the female gametophyte shows numerous abnormalities which render it incapable of fertilisation. Here the cells of the inner integument proliferate and give rise to two to six embryos. The third race is of an intermediate nature with some ovules of an ovary following the first mode of development and others the second mode.

Although the Dacca and Nepal collections of *S. australis* have not revealed the variability found in *S. cernua*, the occurrence of parthenogenetic development in our plant is of interest

as indicative of a tendency towards apomictic development in the genus *Spiranthes*.

Department of Botany, P. MAHESHWARI.
University of Delhi, S. NARAYANASWAMI.
Delhi,
May 23, 1950.

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THE OCCURRENCE OF A VELAMEN AND MYCORRHIZA IN THE SUBTER- RANEAN ROOTS OF THE ORCHID *SPIRANTHES AUSTRALIS* LINDL.

It is well known that the aerial roots of most epiphytic orchids are characterised by the possession of a velamen which is composed of one to several layers of cells many of which show spiral thickenings on their walls. In terrestrial orchids, however, the occurrence of a velamen is rare having been recorded so far in only half a dozen plants. Recently Lakshminarayana and Venkateswarlu (1950) have described it in a species of *Eulophia* R. Br.

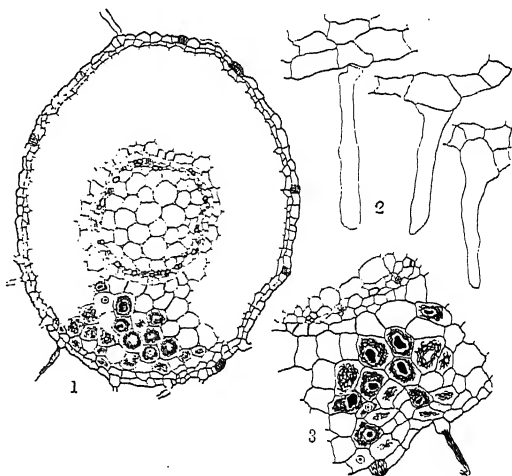


Fig. 1. T. S. root of *Spiranthes australis* showing velamen-like thickenings in cells of the epidermis. $\times 80$. FIG. 2. Proliferation of root hairs. $\times 480$. FIG. 3. T. S. part of root showing endotrophic mycorrhiza and a velamen cell. $\times 180$

A single layer of velamen cells has been observed by me in the subterranean roots of the terrestrial orchid *Spiranthes australis* Lindl., material of which was collected from Dacca in the year 1943. Sections of these roots revealed the existence of isolated cells of the epidermal layer showing reticulate thickenings with perforations characteristic of velamen cells (Fig. 1). That these cells are modified epidermal cells was evident from the fact that the root hairs were also seen to originate from them although later they became cut off from the epidermis by the formation of a partition wall (Fig. 2).

A very prominent endotrophic mycorrhiza is present in the cortex (Fig. 3), the fungus hyphae making their way through the root hairs. Whether this triple occurrence of a cortical mycorrhiza, a piliferous layer and velamen cells is an adaptation to dry conditions, as supposed by Lakshminarayana and Venkateswarlu, is open to question as the material of *Spiranthes* came from a wet marsh.

I am indebted to Prof. P. Maheshwari for providing the material and helping me in my observations.

Dept. of Botany, S. NARAYANASWAMI.
University of Delhi,
May 24, 1950.

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ON PYRILLA INFESTATION AND VARIETAL RESISTANCE IN SUGARCANE

PYRILLA, as a pest, is of major economic importance in certain parts of this sub-continent, e.g., the Punjabs, and the western

irrigated tract of the Uttar Pradesh. In Bihar, however, its occurrence is sporadic and it is, therefore, reckoned among minor insect pests, except in some factory-areas where it appears to be endemic. From annual pest survey carried out at harvest, it was found that only in four out of 29 factory-zones, its average infestation during three years (1944-45 to 1946-47) exceeded 10 per cent., the highest being 14.58 per cent. of the remaining 25 reserve areas, it was below 5 per cent. in 17 of them (Khanna, 1948).

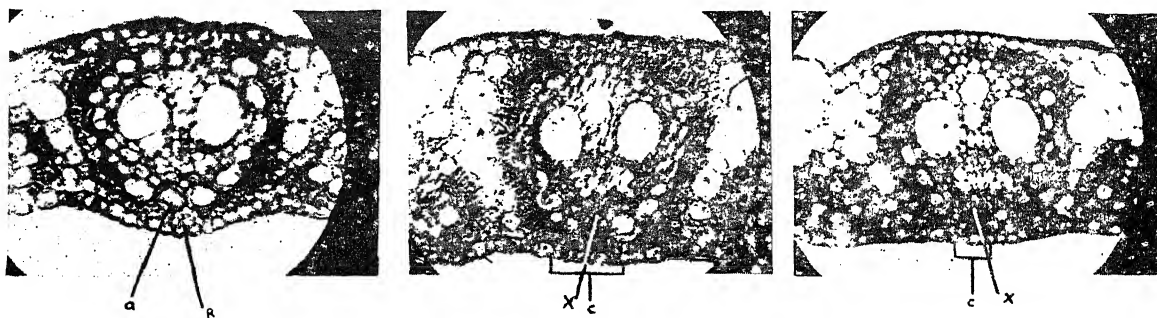
That some varieties were more susceptible to its attacks than others would admit of no doubt. Detailed observations on pyrilla infestation taken at Motipur (Muzaffarpur District) in 1948-49 (Table I) showed that varieties were significantly different from one another in this respect. Thus the percentage of leaves having egg-masses and the average number of egg-masses per infested leaf were lowest in B.O. 3 and were significantly different at 1 per cent. level respectively from the corresponding highest figure in B.O. 11 and B.O. 24. Differences between the latter two varieties in respect of both of them were not significant even at 5 per cent. level. It may therefore be stated that B.O. 3 was the least susceptible to pyrilla attack and B.O. 11 and B.O. 24 the most. Elsewhere also, this differential behaviour on the part of the host has been noted (Gupta, 1948 and Singh, 1949).

The obvious difference between these varieties is that B.O. 3 has shorter and narrower leaves than those of B.O. 11 and B.O. 24 and that the leaves of B.O. 3 form a greater obtuse angle of divergence with the stalk than those of B.O. 24. In B.O. 3 and B.O. 11, they are stiffly held up in air fan-like while in B.O. 24

TABLE I

Infestation of sugarcane varieties by pyrilla and their leaf characters

Variety	Infestation			Leaf characters			
	Percentage of affected leaves	Egg-masses per affected leaves	Eggs per egg mass	Length in cm.	Maximum width in cm.	Area in sq. cm.	Angle of divergence between stalk and sixth leaf
B.O. 10	38.55	4.36	32.97	127.34	4.00	457.01	151.63
Co 453	50.07	4.34	34.88	119.41	3.71	406.99	150.90
B.O. 3	26.93	2.66	33.88	116.72	3.62	277.40	156.27
B.O. 24	45.61	5.30	32.73	107.42	4.20	399.75	150.32
B.O. 11	50.07	3.99	31.85	128.53	5.05	532.47	155.51
General mean	41.55	3.99	33.55	119.88	4.12	414.72	152.93
S.E.	9.06	1.13	4.97	..	..	40.8	0.99
C.D. at 5%	10.67	1.33	5.85	..	..	113.13	3.02
C.D. at 1%	14.38	1.79	..	..	..	148.69	3.97



T. S. of Lamina. Fig. 1, B.O. 11; Fig. 2, B.O. 3; Fig. 3, B.O. 24. The vascular bundle in B.O. 11 is surrounded by a layer of parenchymatous cells (a), thus separating the vascular sheath and the sclerenchymatous rib (r) below it. In B.O. 3, on the other hand, it is interrupted at x where a protective covering (c) is formed over phloem, the tissue tapped by *pyrilla*, for its nutrition. In B.O. 24, the protective covering, though present, is much smaller and thinner than that found in B.O. 3, ($\times 250$).

they are more or less drooping. As a result, the micro-climate within the crop of these varieties is bound to be different. Although observations on temperature and humidity could not be taken, it is obvious that the micro-climatic conditions in a broad-leaved variety would be more congenial to shade—and humidity-loving *pyrilla* than in that having comparatively narrow and short leaves, because the atmosphere, in the former being less strongly insolated, the temperature remains low and humidity does not fall.

Apart from these gross differences in the morphology of leaf, the varieties differ in its anatomical structure as well. The vascular bundles in the lamina of B.O. 11 are more or less completely surrounded by a layer of large thin-walled parenchymatous cells (Fig. 1). Consequently the vascular sheath and the sclerenchymatous rib below it, do not form a protective covering similar to that found in B.O. 3 (Fig. 2) over phloem, the tissue tapped by *pyrilla* for its nutrition. Thus in the latter variety there are 4-6 layers of sclerenchymatous cells as against 2-3 in the former between the dorsal epidermis and phloem which therefore is better protected in B.O. 3 than in B.O. 11. Although the sclerenchymatous shield over phloem is present in B.O. 24 also, it is much smaller and thinner than that of B.O. 3 (Fig. 3).

Further work on the problem is in progress.
Central Sug. Res. Station, K. L. KHANNA.
Pusa, S. L. SHARMA.
May 25, 1950. M. Z. HUSSAIN.

2. Khanna, K. L., *Ann. Rep. Cent. Res. Sta., Bihar, Pusa*, 1948, pp. 92-3. 3. Singh, H. B., *Ann. Rep. Sug. Res. Sch. E. Punjab*, 1949, pp. 39-40.

AN AUTOTETRAPLOID IN THE PEARL MILLET

THE germinated seeds and seedlings of *Pennisetum typhoides* Stapf. and Hub., were treated with colchicine both as an aqueous solution and as an emulsion in lanolin. The concentrations of the solution varied from 0.01 to 1.0 per cent. and at durations from 3 hours to 48 hours. In

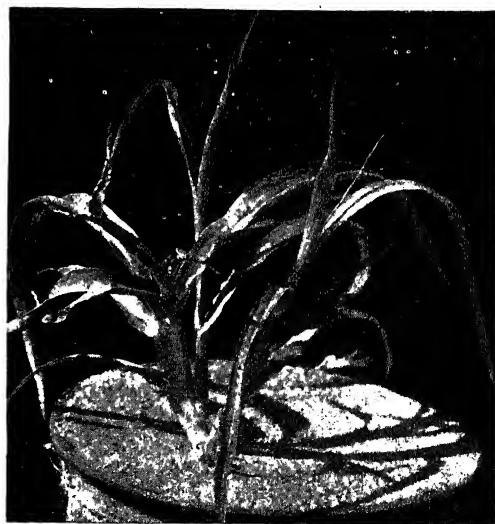


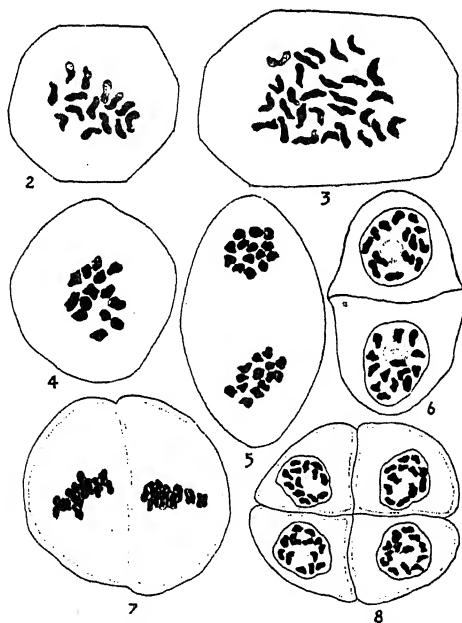
FIG. 1. Induced $4n$ plant ($\frac{1}{5}$ nat. size)

all these attempts seedling mortality was very high, the roots having failed to develop further. Whenever adult plants were obtained they were found to be invariably unaffected. Techniques

in which the roots would be least brought into contact with colchicine were also tried. In one of them aqueous colchicine solution was forced into the tissues under reduced pressure. Out of twenty seedlings treated thus one seedling with abnormal growth was noted. This plant had crinkled, thick leaves with slow emergence (Fig. 1). An examination of the stomata and the tips from adventitious roots gave the following:—

Plant	2n chromosome number	Variation in length of stomata		Mean stomatal length
		Min.	Max.	
Normal	14 (Fig. 2)	25 μ	36 μ	32 μ
Treated	28 („ 3)	45 μ	55 μ	49 μ

The first panicle was rather small. The meiosis was cursorily examined in this panicle. The P.M. cells showed formation of quadrivalents and at first division metaphase plate 14_{II} were counted. The first telophase showed 14_I



Figs. 2 & 3. Somatic chromosomes. Figs. 4-8. Meiosis in 4n plant. 4-metaphase-I; 5-early telo-I with 14-14, distribution; 6-interkinesis; 7-meta-II; 8-tetrads. (All camera lucida drawings $\times 2,200$). Reduced in reproduction by $\frac{1}{2}$.

distributed to each pole (Figs. 4 to 8). The meiosis is remarkably regular. The second division is normal with formation of regular tetrads. The treated plant is thus an induced

autotetraploid, reported for the first time in this plant.

In this species an autotriploid occurring naturally was already described.¹ The subsection *Penicellaria* of the genus *Pennisetum* will thus come to have two tetraploids, viz., *P. purpureum* Schum., the Napier grass and the autotetraploid now reported in *P. typhoides*. An allotetraploid with $2n = 28$ derived from a cross between the two species *P. typhoides* and *P. purpureum* has also been obtained and will be described elsewhere. A detailed account of this autotetraploid is under preparation.

Cytogenetics Laboratory, N. KRISHNASWAMY.
Agri. Res. Institute, V. S. RAMAN.
Lawley Road P.O., N. HRISHIKESAN NAIR.
Coimbatore,
May 28, 1950.

1. *Proc. Ind. Acad. Sci.*, 1941, 13, No. 1, p. 9.

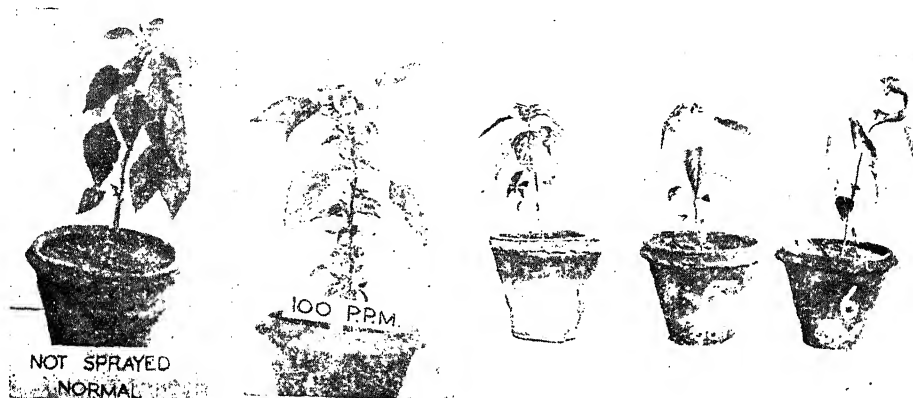
SOME REACTIONS INDUCED BY 2, 3, 5 TRI-IODOBENZOIC ACID ON CHILLIES—*CAPSICUM ANNUUM* L.

THE observations of Zimmermann and Hitchcock⁴ in 1942 on the florigenic properties of 2, 3, 5-tri-iodobenzoic acid on tomatoes stimulated several workers²⁻⁵ to study its reactions on various herbaceous plants.

Excepting Waard and Rodenberg,⁵ the others found no response with soybeans, flax, sunflower, alfalfa, etc., in their attempt to induce flowering in vegetative shoots. Galston² stated that tri-iodobenzoic acid does not possess florigenic properties but augmented flowering response due to photoperiodic induction in soybeans. Zimmermann and Hitchcock⁷ in their latest review on 'plant hormones' have observed that there are no definite indications to consider tri-iodobenzoic acid as having florigenic properties, thus revising their previous observations.⁶

Trials were conducted at Bapatla to study the reactions of 2, 3, 5-tri-iodobenzoic acid with chillies (*Capsicum annum* L.). Young seedlings were sprayed with this hormone at 25, 50 and 100 p.p.m. in water. Within 24 hours of spraying, the apical portions and the lower leaves showed epinasty. Subsequent unsymmetrical petiolar growth led to the curvature of the stalk. The leaves recovered to their original position in the next 48 hours making one loop.

A week later, axillary buds were found stimulated giving rise to lateral growths in



almost every leaf axil. The newly produced leaves were very much distorted, diminished, irregular in size and showed similar curvatures at their tips. In some plants treated with concentrations over 100 p.p.m., a few of the newly formed leaves from the axillary positions wilted due to premature abscission. The plants were stunted due to growth inhibition at the apical meristem and flowering occurred late in clusters of two or three, proportionate to the fusion of the axils. These effects were pronounced with increasing concentrations. The photographs above illustrate these peculiarities.

With tomatoes, leaf distortion, stimulation of axillary buds, inhibition at the apical meristem were observed. Blossom production was delayed and panicles with stout peduncles, proliferated floral parts were induced as in chillies. The vegetative parts showed only distorted growth but none of these were transformed to flowering shoots.

In mangoes (*Mangifera indica*) no reaction was noticed even when 100 p.p.m. was used. At higher concentrations, in a few cases, sprouting buds showed mild form of distortion. But they recovered from these effects and eventually grew normally. The hormone completely failed to exhibit any florigenic properties in any of these plants, but stimulated the growth of dormant axillary buds. Further studies are necessary to exploit its use as an effective agency for breaking bud dormancy.

Plant Physiology L. VENKATARATNAM.
Laboratory, K. SATYANARAYANMURTHY.
Agricultural College,
Bapatla,
May, 1950.

Bot. U.S.S.R., 1946, **31**, 13-21. 5. Waard, J. P., and Rodenberg, J. M. M., *Proc. Koninklijke Akd. Amsterdam*, 1948. 6. Zimmermann, P. W., and Hitchcock, A. E., *Contrib. Boyce-Thompson Inst.*, 1949, **15**, 353. 7. —, *Ann. Rev. Biochem.*, 1948, **17**, 600-23. 8. —, *Contrib. Boyce-Thompson Inst.*, 1942, **12**, 321-43.

A PRELIMINARY NOTE ON THE KARYOTYPE OF *LAUNAEA* *NUDICAULIS* LESS.

Launaea nudicaulis Less., a member of the Cichoreæ tribe of the Compositæ, is a common weed of Saurashtra. The only previous work in this genus is by Hagerup,¹ on *Launaea integrifolia* from Sudan, with a diploid number $2n = 16$.

The somatic complement is made up of eighteen chromosomes (Fig. 1). Of these, one pair is long and one of medium size, with sub-median centromeres, and sub-terminal secondary constrictions. Besides, there are, a pair of very long and three pairs of medium sized chromosomes. Lastly there are three pairs of small chromosomes which show a gradual reduction in size. All the chromosomes have median or sub-median centromeres (Fig. 2).

Meiosis is normal except for every occasional lagging of a bivalent. During zygotene and onwards, two bivalents are seen to be attached to nucleolus. Pairing is very regular and nine bivalents are always formed to the exclusion of any multivalents.

The arrangement of the bivalents of the metaphase plate is not always uniform and there is an indication of secondary association, which means of the species under examination is not a true diploid. This is further strengthened by the fact that there are two pairs of nucleolar chromosomes.

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2. Galston and Arthur, W., *Am. Jour. Bot.*, 1947, **34**, 356-60. 3. Owen, O., *Ann. Rep. Ind. Expt. Sta. Bul.*, 1946, **32**. 4. Tumanov, I. I., and Lizandr, A. A., *Jour.*

Hagerup (*loc. cit.*) states that there is not sufficient evidence to conclude that *L. integrifolia* is a polyploid.

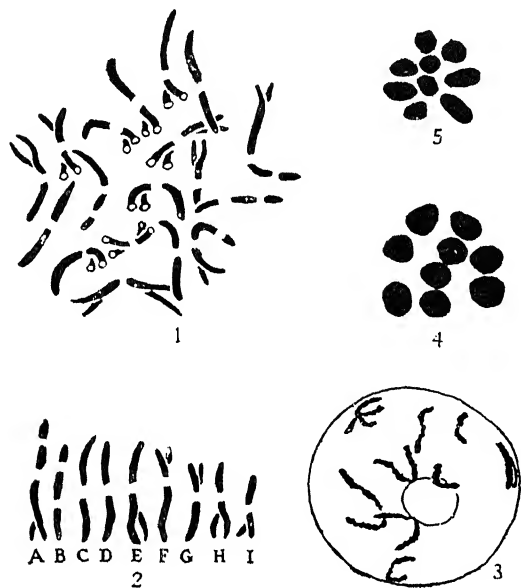


FIG. 1. Somatic metaphase plate. ($\times 3,700$).

FIG. 2. Idiogram. ($\times 3,700$).

FIG. 3. Nucleus at diakinesis stage of meiosis, showing the attachment of two bivalents to the nucleolus. ($\times 2,600$).

FIGS. 4 & 5. First metaphase plates, ($\times 2,600$ and $\times 2,200$ respectively).

Further work is in progress. My sincere thanks are due to Dr. V. P. Varde, Samaldas College, for providing the necessary facilities.

Samaldas College, M. H. S. MURTHY.
Bhavnagar,
Saurashtra,
June 8, 1950.

1. Hagerup, *Hereditas*, 1932, 16, 20.

DOUBLING OF CHROMOSOMES IN THE ROOT TIPS OF MUSA

DOUBLING of the somatic chromosomes (with $2n = 44$) was observed in the root tip cells of *Musa sanguinea*, a wild species (Sub-genus *Rhodochlamys*) and in *Safet-velchi*, a cultivated variety of *Musa paradisiaca* (Sub-genus *Eumusa*). Both have normally $2n = 22$ chromosomes (Fig. 1) in their somatic cells.¹ Occasionally abnormal cells with double the number of chromosomes are also found as shown in Fig. 2. In one particular case it was noticed that each chromosome had split along the centromere region into two sister chromatids, lying side by side, which had not moved

away as happens in normal cases of mitotic division.

From the above one may infer the manner of doubling of the chromosomes to be through the arrest of the anaphase stage by the failure of the spindle mechanism, the coming closer together of chromosomes and the formation of a new nuclear membrane along the tetraploid chromosome complement.

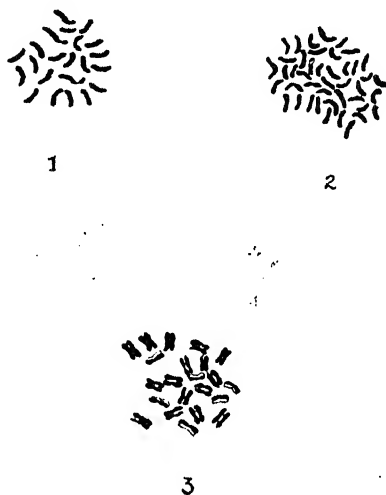


FIG. 1. Normal mitotic metaphase plate in *Safetvelchi* showing $2n = 22$ chromosomes. $\times 1,900$.

FIG. 2. Abnormal mitotic metaphase plate in *Safetvelchi* showing the doubled number of chromosomes (44 chromosomes $x = 11$). $\times 1,900$.

FIG. 3. Arrested anaphase in the mitosis of *Musa sanguinea*. The sister chromosomes lie parallel. $\times 1,900$.

The edible bananas are mostly triploids with $2n = 33$ ($x = 11$). A few varieties like *Sefet-velchi*, although seedless, are diploids. The triploids might have originated from the diploid types either by the union of reduced and unreduced gametes or by the union of a gamete of a hitherto unrecorded tetraploid species with $2n = 44$ chromosomes and a normal reduced gamete of a diploid species. Cheeseman's work in Trinidad on the production of *Musa* tetraploids artificially lends support to this view.

Since chromosome doubling has been observed in root tip tissue a similar occurrence in the stem is also possible. We may even hope to discover a tetraploid *Musa* in nature.

M. A. C. S. Laboratory, S. GOVINDASWAMI.
Poona 4,
June 2, 1950.

1. Govindaswami, S., *Proc. Int. Sci. Cong.*, 37th Session, 1950.

REVIEWS

Plane and Spherical Trigonometry. By Palmer, Leigh and Kimball. Fifth Edition with Tables, (McGraw Hill Book Company, Inc.), 1950. Pp. xiii + 266 + 102.

The first edition of this book came out in 1914 and the fact that there is a demand for its fifth edition today bears testimony to its popularity with the class of readers for whom it is written. The first 190 pages are devoted to an elementary treatment of plane trigonometry which is followed by 76 pages on spherical trigonometry. The five-figure logarithmic and trigonometric tables in the end cover 102 pages and constitute what is from the readers' point of view the most valuable and useful part of the book in the long run.

The book provides an excellent introduction to plane trigonometry and the first year students of a college course will find the exercises, diagrams, explanations and lists of formulæ and useful constants of immense help in cultivating an acquaintance with the subject. The printing and get-up of the book are so attractive that the young reader will easily fall in love with trigonometry at first sight.

The treatment of spherical trigonometry is less thorough, more sketchy and definitely disappointing at several places. The proof of a basic formula like the cosine formula is incomplete in as much as all possible cases are not covered. There is a noticeable lack of good exercises. Teachers usually find that an insight into the formulæ of spherical trigonometry develops only after the student has worked out a number of geometrical exercises having Euclidean analogues. There are, however, compensating features and the overall impression left on the reviewer's mind, in the end, is quite pleasing. V. V. N.

Jacob Steiner's Geometrical Constructions with a Ruler. Translated from the first German edition (1833) by M. E. Stark and edited with an Introduction and Notes by R. C. Archibald. (*Scripta Mathematica*, Yeshiva University, New York), 1950. Pp. 88. Price \$0.70.

Stark and Archibald have done a service to the English-knowing class of mathematical readers by bringing out this classic work from German into English. In his own days, Steiner came to be known as the greatest geometer since Apollonius. The work, of which a trans-

lation appears in the book under review, was published shortly after Steiner had laid the foundations of modern synthetic geometry in his remarkable work of 1832. The question that is taken up here is whether it is possible "to solve all geometrical problems by means of the ruler alone, if any fixed circle is given in the plane". It is shown that this question is answered in the affirmative if certain fundamental problems, eight in number, are solved in this manner. The most important are the seventh problem of finding the points of intersection of a given line and a circle whose size and position are given, and the eighth problem of finding the points of intersection of two given circles.

There is an intellectual thrill in the successful carrying out of the above programme which, with a knowledge of elementary geometry, it is possible for any reader of this book to experience. For the reader who is less susceptible to pure intellectual feats and who is rather utilitarian in outlook, there is an Appendix, in which it is shown how the method of the ruler and a fixed circle leads to simple solutions of several problems that appear difficult. There are twenty-two such problems considered in the Appendix. The extensive notes given in the end are quite useful to the reader and make the work a scholarly translation. The book deserves a place in every college and university library. V. V. N.

The Natural Philosophy of Plant Form.—By Agnes Arber. (Cambridge University Press), 1950. Pp. 246. Illustrated. Bibliography. Price 25 s. net.

In these days of specialisation, when the different branches of botany tend towards isolation and often the plant itself is forgotten, a philosophical and synthetic treatment of the plant morphology, as presented here by the gifted author of *Plant Form*, will be enthusiastically received by research botanists the world over.

By careful historical study, the author proves the necessity for reviewing the works of pioneers like Aristotle, Theophrastus, Goethe, De Candolle, etc. These pioneers, Mrs. Arber has rightly pointed out, being free from any fixed scheme of evolutionary preconceptions, were at liberty to concentrate on form itself. It is stressed throughout the book that the in-

dividual organism should be realised as consisting of a unification of every phase of its existence from the fertilized ovum onwards rather than as a summation of stages.

The eleven chapters of the book deal with a historical re-examination of plant morphology, Goethe's "Urpflanze" concept, the partial-shoot concept leading to the idea that all appendages are shoots, the type concept including the "Gestalt" type of Troll, the idea of parallelism and finally the mechanism of plant morphology and the interpretation of morphology. The get-up of the book is excellent. On page 191, Zimmermann (1935) has been cited, while in the bibliography only 1930 has been listed, probably by typographical mistake.

N. K. S.

Text-book of Inorganic Chemistry. By J. R. Partington, M.B.E., D.Sc. Sixth Edition. (Macmillan & Co.), 1950. Pp x + 996. Price 25 sh.

The first edition of this well-known text-book appeared in 1921, and the fifth edition in 1937 with several reprints later. For a remarkably clear, concise and authoritative presentation of the subject, Prof. Partington's book easily takes the first place. Text-books on inorganic chemistry are abundant in the market, and each one has some characteristic feature of its own; for example, one emphasises the historical aspect, another the industrial, a third the experimental, and so on. But in the reviewer's opinion (shared by many of his colleagues) there is no single book to compare with Partington's for a judicious combination of all the features of a good text-book, an opinion which he has held unshaken from the appearance of the first edition. The reviewer has watched expectantly for the appearance of every new edition and has always been rewarded by finding something refreshingly good and new. The amount of care which the author has bestowed on the collection and sifting of the material and presentation of the same in a form easily intelligible to an average student elicits admiration. Some of the abstruse topics which bewilder sometimes even the teacher when he tries to prepare his lectures from the original papers or technical treatises are handled in Partington's text in such a concise and clear manner that it is advisable to read Partington's treatment of the subject before going to the higher treatises to keep one's sense of proportion. As instances may be mentioned the chapters on "Complex Compounds" and on the "Structure of Silicates".

In this edition, the old sections on atomic structure and electronic theory of valency have been extended and new sections on directed

bonds and resonance have been added. The chapters on physical chemistry essential to an understanding of inorganic chemistry which were a characteristic feature of earlier editions have been retained with additional useful material.

In the reviewer's opinion the section on the action of nitric acid on metals requires revision taking into account the electromotive series of metals; the chapters on fluorine and zero group elements do not mention recent developments on the subjects. The reviewer has noted a small error in the electronic structural formula III of nitric oxide on page 437.

The book can be confidently recommended as an authoritative presentation of the subject of inorganic chemistry to all University Pass course B.Sc. students. Honours and post-graduate students will also find many chapters very useful; for them, however, there is another book by the same author, namely, *General and Inorganic Chemistry*, which is an expanded edition of the one under review.

M. R. N.

Technique of Organic Chemistry, Vol. III. Edited by A. Weissberger. (Interscience Publishers, New York), 1950. Pp. 661. Price \$10.

The third volume of this series, of which the first and second volumes dealt with physical methods of organic chemistry, catalytic, photochemical and electrolytic reactions, enters the field of chemical engineering. Unit operations are treated from the point of view of the preparation of organic compounds in the laboratory. Because of their importance and the space required for their treatment, distillation and adsorption are to be considered separately in Volumes IV and V. The eight chapters of Vol. III cover Heating and Cooling; Mixing; Centrifuging; Extraction and Distribution; Dialysis and Electrodialysis; Crystallization and Recrystallization; Filtration; Solvent Removal, Evaporation and Drying.

The organic chemist in academic laboratories, especially in this country, is apt to be content with obtaining a desired product and to ignore the quantitative aspects of the reactions, the relative advantages of various conditions under which the reactions can be carried out, and the technique of isolation which leads to the maximum yield of pure product. A good knowledge of the available tools and technique and competence to handling them are obviously essential for the industrial research laboratory engaged in collecting data on the basis of which plant is to be designed and large-scale

production is to be undertaken; they are equally important for the academic chemist investigating complex problems of degradation and synthesis, particularly when he has limited funds at his disposal and has to work up his reactions by carefully chosen methods so that the products and by-products can be isolated as completely and economically as possible. Weissberger's series, including the volume under review will, therefore, be of material assistance to academic and industrial organic chemists alike.

The theoretical background of each unit operation is explained fully before experimental methods and applications are described. There are few experimental difficulties for which a likely solution will not be found in this volume. A simple example is the bumping of boiling liquids for which a page is devoted. The chapters on extraction, crystallization and filtration, occupying nearly two-thirds of the book, are exceedingly useful surveys, except that the chapter on filtration is unduly concerned with pilot plant work and one will not find the solution for several laboratory problems such as the filtration of an ether solution with the room temperature at 25–30° C. The chapter on extraction and distribution (L. C. Craig and D. Craig) gives an account of the very important technique of countercurrent distribution with which L. C. Craig's name is associated and which has been applied with great success to studies of penicillin, gramicidin and other antibiotics. A glass apparatus for large numbers of transfers, designed by Craig and still under development, is described; the new apparatus can give a ten-fold increase in the numbers of transfers compared with the steel type of countercurrent distribution apparatus. The chapter on mixing contains useful information, e.g., on many types of laboratory stirring devices including a seal for stirring in vacuum; it also helps the novice to realize that higher speed does not necessarily mean better mixing. The theory of centrifuging is very clearly explained and the significance of relative centrifugal force (R.C.F.) is stressed.

There are a few minor errors such as "dichlorodifluoroethane" instead of "dichlorodifluoromethane" in line 26 of p. 82, "benzene", instead of "benzoate" in line 12 of p. 103, and "0.6" instead of "0.7" in line 8 of p. 282. Removal of water by means other than vaporization has been used commercially (than vapour p. 633), e.g., in the displacement of water by alcohol in cellulose nitrate and in the flushing of pigments. An omission in the chapter on

heating and cooling is thermostatic control of temperatures below room temperature.

K. V.

Biology—An Introduction to Medical and Other Studies. By P. D. F. Murray. (Macmillan & Co., London), 1950. Pp. viii + 600, 381 figures. Price 25 sh.

This is not one of those books comprising of two parts, one dealing with botany and the other with zoology, bound under one cover and called a book on biology. The author, who has a wide teaching experience in biology, apparently believes in that biology is a synthesis rather than the mere addition of botany to zoology or *vice versa*. He has, therefore, dealt with the chapters on plants and animals in close proximity in the earlier part of the book and has presented the subject-matter generally in a comparative manner. Later, greater stress had been laid on the parallelism between the evolution of land plants and land vertebrates and towards the end, the book is mostly devoted to physiological topics, growth, behaviour of organisms, etc., where, as in the earlier part, the comparative method has been employed.

The author thinks that "it is likely that the near future will see closer co-ordination than is at present usual between the work which medical students now do in their first year, and their later studies in anatomy, physiology, biochemistry and pathology". He has, accordingly, dealt with the subject which forms the basis of these specialized studies in greater details, and has thus provided the student with a book which tries to bridge the gap existing between their premedical and medical courses. This attempt has no doubt been partly responsible for the large size of the book. Another reason is the author's belief that many medical students are willing to read beyond the narrow limits of a syllabus if the matter is relevant to one's vocation and is attractively presented. The number of such students would naturally vary in different places but one would agree with the author in general.

Dr. Murray has presented his subject-matter attractively, simply, and in an undogmatic manner; the text is well illustrated with a large number of original, clearly drawn and very instructive figures which are stated to be made from specimens. One, however, feels that in certain matters, such as the Classification of Animals, the author may have well avoided the use of the term "Grade" under which he groups one or more phylla. Evidently subjects like classification, genetics and evolution, deserved a more thorough treatment

greater space, than that given at present. There is no doubt that this book will go through several editions, when, we hope, the author will find it possible to expand some of these parts.

A. P. KAPUR.

Advances in Enzymology, Vol. X. Edited by F. Nord. (Interscience Publishers, Inc., New York), 1950. Pp. ix + 533. Price \$5.00.

The tenth volume of the *Advances in Enzymology* consists of nine contributions, more than half of which have emanated from the European Continent, including Germany. The subject of blood-clotting and related processes is reviewed by Tage Astrup, who has given a useful summary of the new experimental techniques recently developed in connection with studies on the mechanism of coagulation. The subject of blood-clotting has attained added practical significance in view of the ever-widening practice of blood transfusions. Attention should be called to the profitable and thought-provoking conception of blood not as a passive supporting medium, but as a carrier of "a large stock of proteins serving as precursors of biologically active substances. Upon the injection of specific activating substances into the blood stream, these will be transformed into substances of highly specific biological activity". The preparation, properties and mechanism of action of a relatively unknown enzyme, leucophaenase, constitute the subject of a review by Frank C. Happold. The histo-chemical reaction, preparation and purification of alkaline phosphatases and the factors which influence their activation, and the dissociability and reconstitution of the enzyme complex, are discussed in the third contribution by Roche and L. de Paris. Hassid and Doudoroff, who have accomplished the enzymatic synthesis of sucrose, have reviewed the field of the synthesis of carbohydrates with bacterial enzymes. Brink and Folkers have "described and correlated the important factors of the isolation and chemical reaction which have been carried out on some of the outstanding antibiotics produced by the streptomyces group of organisms with special reference to streptomycin." The problem of the citric acid cycle has been reviewed from a refreshingly original angle by Martius and R. N. Of particular interest is the article on *phytochemie des Schwefels* by Theodor W. N., whose own contributions in this field have been both fundamental and extensive. The role of sulphur in conferring certain types of physiological activities to the molecule of

which it forms a part, is discussed in this article. The function of sulphydryl groups in the activation of enzymatically active proteins, the functional significance of sulphur-containing amino acids and peptides, are reviewed.

A continuation of the review (Part II) of the chemical changes in the harvested tobacco leaf appears in this volume. C. E. Zobell, the well-known marine microbiologist, contributes a review on the *Assimilation of Hydrocarbons by Micro-organisms*.

The articles are sumptuously documented with references to original literature. A helpful author index, a comprehensive subject index and a cumulative index to the ten volumes of the *Advances* which have so far appeared, enhance the usefulness of this volume. With the appearance of the tenth volume, Prof. Nord may be said to have established this series on a permanent footing. Prof. Nord, who has earned the gratitude of the biochemists in general, may well congratulate himself on this achievement.

Efficient Use of Fertilizers. Edited by Vladimir Ignatieff. (Food and Agricultural Organization of the U.N.O., Washington, U.S.A.). Pp. x-182. Price \$2.00.

This little book of 183 pages is published as the ninth number of the F.A.O. Agricultural Studies. Thirty-six authors have contributed to its production and portray the experience of agricultural investigators throughout the world. An F.A.O. publication needs no special praise and is a guarantee of its quality. Each one of its eight chapters summarizes in crisp and yet simple language the matter under study. In the first chapter the role of fertilizers, covering fertilizers in the farming system, kinds of fertilizers, manures and sustained production goals are dealt with. In the second the sources, the availability, need for balance, symptoms or deficiencies, toxic effect of excess of plant nutrients and the effect of some elements on animals are described; chapter three sets out the necessity of organic matter to the soil and the various sources for obtaining it such as animal refuse, composts, night-soil and sewage. This is followed up by the next chapter detailing commercial fertilizers and soil amendments. Chapter five describes the usage of fertilizers and soil amendments. Chapter six deals with crop sequences and fertilizers and chapter seven plant nutrient relationships to soil regions. In chapter eight, the scientific and economic aspects of soil management are dealt with.

This book will be of use to the farmer, the student, the teachers of agricultural chemistry and all extension service officers as it contains ready references to many problems that face them every day. A very welcome feature of this book is the list of carefully selected references found at the end of each chapter which are suggested for further study. Printed well on excellent paper, with few mistakes, this book sets up a standard for scientific information presented in popular language—an extension service well worthy of the F.A.O. It is all the more welcome at present, as the efficient and economic use of fertilizers the world over is a necessity if the ever-increasing needs of a hungry world are to be met satisfactorily.

N. G. C.

Survey of Biological Progress Vol. I. Edited by George S. Avery Jr. (Academic Press Inc., New York), 1949. Pp. 396. Price \$6.80.

Biologists who are constantly confronted with the complexities of living matter, are always eager to learn and benefit by the advances in technique and in the methods of approach made in allied branches of science. Most of them, however, have neither the time nor often, the introductory background to keep pace with the literature massing in other fields. The *Survey* under review, in the words of the Editor, "is intended to serve the biologist who wishes to be well informed in fields marginal to or beyond his own special sphere of interests". "By thus providing a medium for integrated presentation of facts and thoughts from all fields of biology, the *Survey* aims to offset in a certain measure the isolating effect of rapidly increasing specialisation."

The present volume consists of eleven reviews:—Teaching biology today, by H. B. Creighton; The genes and gene action, by B. Glass; Tracer methods in biological research, by M. D. Kamen; Nutrition and reproduction, by K. E. Mason; Growth and development, by D. P. Costello; Virus tumors, by L. M. Black; Hormones and the differentiation of sex, by R. K. Burns; Growth hormones and tissue growth in plants, by P. R. White; Newer methods in the rapid development of disease-resistant vegetables, by W. A. Frazier; Influence of environmental factors on the vitamin content of food plants, by K. C. Hamner; Ecological studies on populations, by G. E. Hutchinson. It will be seen that the subjects discussed in the above reviews span a wide field of the biological sciences and we may expect to find in the succeeding *Surveys* a greater variety and number of interesting subjects reviewed for the

edification of the biologist. We have no doubt that these *Surveys* will stimulate new lines of thought and serve to promote the progress of the biological sciences.

The Indian Sugar Industry—1949 Annual.

Edited by M. P. Gandhi. (Gandhi & Co., Publishers, Sir Pherozshah Mehta Road, Bombay). Pp. lxvi + 152.

This familiar and widely-known Annual of the Indian Sugar Industry, gives a valuable survey of the sugar industry and furnishes adequate and useful data pertaining to acreage, yields and costs of production, etc. The author enters a strong but unconvincing plea for a further continuation of protection for the industry after 31-3-50. The volume attains added importance in view of the sugar shortage which faces the country. The author has been rendering great service both to the industry and to the public, by the publication of his highly informative Annuals year after year on this important industry.

The Indian Cotton Textile Industry (Annual 1949). Vol. XII. By M. P. Gandhi; with a

Foreword by the Hon'ble K. C. Neogy. (Published by Messrs. Gandhi & Co., Jan Mansion, P. M. Road, Fort, Bombay), Nov. 1949. Price Rs. 6.

This is another of these informative Annuals on the Indian Cotton Textile Industry, the twelfth by the author, giving an extensive and illuminating picture of the industry's struggles and triumphs during the past two years. In this era of controls and restrictions on every conceivable phase of the industry it is necessary periodically to survey critically the effects of the policy of Government in this behalf and the reactions of the producer and the consumer. The period under review is chiefly characterised by the reimposition of control late in 1948 and its relaxation in late 1949, enquiry and report by the Tariff Board and price fixation of yarn and cloth, and the repercussions of devaluation. The book gives a historical summary and review of the factors that influenced production, consumption and price movements of cotton, yarn and cloth. References to the successful attempts being made for the manufacture of textile machinery as well as accessories, etc., in India, are also given. The position of raw cotton in relation to the country's requirements, particularly after the partition, are discussed. The handloom industry is as usual given an independent section (Appendix B) in recognition of the premier position it occupies in the country's economy. Several useful statistical tables

of production and consumption, imports and exports, etc., and control orders as also a list of mills in the country are given.

At a time when the trade is veering round from a seller's to a buyer's market, and the country is developing on the lines of establishing a permanent export market, it is necessary to stabilise the industry's structure by standardising wages in relation to work load, introduction of quality control methods, fresh designs, attractive finishes, use of artificial fibres, pure and mixed with natural fibres, etc. The book gives useful hints in some of these directions. A chapter on the Textile Association

(India) would be welcome. Education for the textile industry, schemes of training within the industry, intensive co-operation between the industry and technical institutions, the sheer necessity for the industrialists to give adequate encouragement to technical personnel in the larger interests of the country and the industry need to be stressed. If information relating to import control orders, licensing authorities, etc., had been included, it would have enhanced its usefulness as a reference book. These would probably be included in the next issue.

SRINAGABHUSHANA.

SCIENCE NOTES AND NEWS

1851 Exhibition Scholarship

The Royal Commissioners for the Exhibition of 1851 (London) have appointed Mr. R. C. Sahney of the National Physical Laboratory, Delhi, to the Science Research Scholarship offered to India this year. The scholarship has been awarded to him for research in Physical Chemistry at Cambridge University.

World Power Conference

The Fourth World Power Conference, which has just concluded its meetings in London, was attended by 1,600 delegates from 47 countries, including India. The leader of the Indian delegation was Mr. A. N. Khosla, Chairman of the Government of India's Central Water-Power, Irrigation and Navigation Commission. Other delegates from India were Mr. N. N. Iyengar, Chairman, Government of India's Central Electricity Commission; Dr. J. W. Whitaker, Director of the Fuel Research Institute, Dhanbad; Prof. M. S. Thacker, Head of the Department of the Power Engineering, Institute of Science, Bangalore; Dr. Lal C. Verman, Director, Indian Standards Institute, Delhi; and Mr. S. A. Gadkari (Central Electricity Authority).

During the conference over 150 papers were presented. Subjects for discussion included atomic energy, preparation of solid, liquid and gaseous fuels, water power, internal combustion engines, and gas turbines.

Commonwealth Defence Scientists' Conference

Senior defence scientists from India and the Commonwealth countries met in London re-

cently with the object of organising and promoting scientific research relating to defence in all fields by closer collaboration within the Commonwealth. There have been previous meetings of defence scientists from the Commonwealth countries, but this is the first to be attended by representatives of India, Pakistan, the U.K., Canada, Australia, New Zealand and South Africa. The Chairman of the Conference was Sir Henry Tizard, Chairman of the United Kingdom Defence Research Policy Committee.

India was represented at these meetings by Dr. D. S. Kothari, Scientific Adviser to the Central Ministry of Defence, who led the delegation; Dr. R. S. Thakur, Scientific Adviser to the Master-General of Ordnance; Col. S. K. Ray of Army H.Q.; and the Army, Navy and Air Force attachés to the Indian High Commissioner in London.

World Universities Roster

The International Bureau of Universities has recently bought and distributed 1,000 copies of *Universities of the World*, thanks to a UNESCO subsidy. This work, published by the American Council on Education, is a roster of Universities and Higher Schools in all countries except the United States, and includes information of an administrative nature and study programmes, as well as conditions of entry for foreign students. Copies bought by the International Bureau of Universities have been distributed free in the Higher Schools and Universities of many Latin-American and Middle and Far Eastern countries which would otherwise have been unable to obtain the publication.

First International Universities Conference

One hundred and twenty-six universities, belonging to 38 different countries, have already agreed to send representatives to the First International Conference of Universities which will be held at Nice between the 4th and 10th of December 1950.

The object of the conference is to create an International Association of Universities. One of the items on the agenda will be a debate on the role Universities should play in relation to material and moral changes which scientific and technical progress have produced in contemporary society. It has been announced that Messrs. Bernardo Houssay (Argentina), Sir Sarvapalli Radhakrishnan (India), former President of the UNESCO Executive Board, and George F. Zook (U.S.A.), will be among the speakers on this subject.

Validity of UNESCO Book Coupons

All UNESCO book coupons at present in circulation are valid until 31st December 1950 and it is extremely probable that their validity will be extended for at least one year beyond that date. An additional two months beyond the validity date are allowed for the presentation by suppliers of coupons to UNESCO for redemption.

Meeting of UNESCO Coupon Scheme

An informal meeting to discuss the development of the UNESCO Coupon Scheme has been scheduled to be held during the period of the UNESCO Fifth General Conference in Florence. All UNESCO Member States have been invited to send a representative to this meeting, at which the development of the Scheme in all its aspects will be discussed.

A special background document (UCS/7) has been prepared for the meeting and can be obtained from the UNESCO Clearing House for Publications, 19, Avenue Kléber, Paris 16e France.

Atomic Product "C-14"

"C-14" is an isotope of the common element carbon, and has a wider range of uses in scientific research than any other isotope. To take only a few examples of its many applications, "C-14" can be used in biology, to study the processes by which food is turned into living matter by animals and human beings; in medicine, to study the behaviour of vitamins, hormones, drugs and cancer producing substances; in agriculture, to investigate how plants such as wheat and potatoes turn carbon dioxide from the air into starch and sugar—also to help in

combating plant diseases such as the tobacco virus; and in industry to study the distribution of carbon in steel or to study the production of synthetic petrol or in the analysis of complicated chemical mixtures, and to study the behaviour of petrol in engines.

To make the new isotope, nitrogen in solid form is "cooked" inside atomic piles at Harwell for 12 months. Even after this long treatment only two in every 1,000,000 nitrogen atoms are converted to "C-14".

Forthcoming Symposium on Trends in Present Day Taxonomy

Under the joint auspices of the Botanical Section of the 38th Indian Science Congress, Indian Botanical Society, Indian Phytopathological Society, Indian Society of Genetics and Plant Breeding and Indian Ecological Society, a symposium will be held on "TRENDS IN PRESENT-DAY TAXONOMY" during the forthcoming session of the Indian Science Congress in January 1951. The (1) Taxonomists of higher plants, (2) Mycologists, (3) Algologists, (4) Plant Pathological Bacteriologists, (5) Plant Breeders, (6) Cytogeneticists, (7) Plant Pathologists, (8) Anatomists, (9) Embryologists and (10) Ecologists are requested to present their respective points-of-view in the symposium.

All those who desire to take part in the symposium are invited to send a synopsis of their views to Dr. B. B. Mundkur, Directorate of Plant Protection, Quarantine and Storage, Ministry of Agriculture, New Delhi 2, by the 15th September 1950. They are also requested to send a duplicate copy to Dr. B. Sanjiva Rao, General Secretary, Indian Science Congress, Bangalore 3.

Research Degree Awards

On the recommendation of the Board of Examiners consisting of Prof. E. J. Bowen, F.R.S., Prof. S. Sudgen, F.R.S., and Prof. G. I. Finch, F.R.S., appointed to adjudicate on the thesis entitled, "Joshi-Effect in Oxides of Nitrogen and Ammonia Vapour", the Syndicate of the Benares University have resolved that Shri. K. S. Visvanathan, M.Sc., be declared qualified for the degree of Doctor of Science.

On the recommendation of the Board of Examiners consisting of Prof. Robert S. Mulliken, Prof. R. W. B. Pearse and Dr. R. F. Barrow, appointed to adjudicate on the thesis entitled "Band Spectra of the Halides of certain Heavy Elements (Ti, Pb, Bi and Mn)," the Syndicate of the Andhra University have resolved that Mr. P. Tiruvenganna Rao, M.Sc., be declared qualified for the degree of Doctor of Science,

On the recommendation of the Board of Examiners consisting of Sir Robert Robinson, Prof. Wilson Baker and Prof. A. R. Todd, appointed to adjudicate on the thesis entitled "Application of Nuclear Oxidation Methods for the Synthesis of Some Pyrone Derivatives Occurring in Nature", the Syndicate of the Andhra University have resolved that Mr. V. V. Sriramamurty, M.Sc., be declared qualified for the degree of Doctor of Science.

Pan-Indian Ocean Science Congress to meet in India

India will be the venue of the Pan-Indian Ocean Congress which is being arranged by the Indian Science Congress through the Department of Scientific Research, Government of India. Delegates from over a dozen countries including Australia, New Zealand, Kenya, Tanganyika, Uganda, Burma, Ceylon, Indonesia, Iran, Afghanistan, Malaya, Pakistan and Thailand are expected to attend the Congress which is proposed to be held early in January 1951 side by side with the Indian Science Congress session at a prominent academic centre.

The subjects for consideration at the Congress will be Agriculture, Botany, Chemistry, Economics, Geography and Oceanography, Geology, Physics, Public Health and Nutrition, the Social Sciences and Zoology.

Indian Association for the Cultivation of Science

The Annual General Meeting of the Indian Association for the Cultivation of Science was held on July 25, 1950. In presenting the Annual Report of the Association for 1940-50, Prof. P. Ray, M.A., F.N.I., Hon. Director, reported the satisfactory progress of the construction of the new research building of the Association at Jadavpur. The building was started in March 1949, and by March 1950, major construction work was completed, including some of the sanitary and electrical installations.

During the year under review, a number of distinguished foreign scientists visited the Association either as recipients of the Association's several distinguished medals or as special lecturers. The Joy Kissen Mookerjee Gold Medals for 1947 and 1948 were awarded to Mme. Irene Joliot Curie, Director of Radium Institute, Paris, and to Dr. Arthur E. Morgan, President of the TVA respectively. Prof. Robert Robinson, President of the Royal Society, received the Association's Bimala Churn Law Gold Medal for the year 1945. The Association offered the Bimala Churn Law Gold

Medal for 1949 to Sir Alexander Flemming, the discoverer of penicillin. Prof. Hermann E. Mark, Director, Polymer Research Institute, U.S.A., delivered a course of lectures as Coochibhar Professor of the Association.

The new Department of Organic Chemistry was opened during the year and efforts were made to bring into existence the Department of Theoretical Physics.

Council of the Association for 1950-51.—*President:* Prof. M. N. Saha; *Vice-Presidents:* Dr. J. C. Ghosh, Dr. D. M. Bose; *Hon'y. Director:* Prof. P. Ray; *Members:* Dr. S. R. Bose, Sri Dwijesh Chandra Chakravarti, Dr. B. C. Guha, Dr. Satish Chandra Ganguly, Prof. S. K. Mitra, Prof. P. C. Mahanti, Prof. S. K. Ray, Hon'ble Sri C. C. Biswas, Dr. S. K. Banerji and Dr. P. N. Brahmanachari; *Trustee-Member:* The Hon'ble Justice R. P. Mookerjee; *Nominees of the National Institute of Sciences in India:* Dr. B. B. Dey, Dr. D. S. Kothari; *Nominees of the Govt. of India:* Secretary to the Department of Scientific Research, Educational Adviser to the Govt. of India, Sri M. S. Bhattacharya, Joint Finance Secretary; *Nominee of the Govt. of West Bengal:* Dr. D. M. Sen; *Professor-Member:* Prof. Santi R. Palit.

Neem Tree and Its Products

In view of the growing importance of the neem oil as a commercial product and the long-established medicinal uses of neem, a reinvestigation of the active principles of the oil was taken up in the laboratories of the Council of Scientific and Industrial Research.

By employing a process based on the selective use of different solvents under the mildest possible conditions, a series of new crystalline and amorphous bitter constituents have been isolated from the neem oil in an industrially workable total yield of about 2 per cent. The main active principle has been named *nimbidin* and a number of pharmaceutical preparations with this product have been standardised.

The other constituents, which have been named as *nimbidol*, *nimbin* and *nimbinin* are still under investigation.

ERRATA

Volume 19, No. 1, page 17: Note on "Random Association of Points on a Lattice".

Line 16 from the bottom: *Read 162 for 157.*

Line 12 from the bottom: *Read 2322 for 2292.*

Volume 19, No. 7, page 218: Note on "Control of Loose Smut of Barley".

Line 2 from the bottom: *Read "Jensen" for "Rostr.")*.

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Current Science



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SEPTEMBER 1950

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THE GREAT ASSAM EARTHQUAKE OF 15TH AUGUST 1950

ON the evening of the 15th August 1950, about forty minutes past seven, an earthquake of catastrophic violence occurred off the north-east border of Assam. The earthquake was recorded by the seismological observatories all over the world as a very great earthquake and various adjectives such as tremendous, very violent, unprecedented, biggest ever recorded, have been used to describe the magnitude of the earthquake. It is one of the biggest ever recorded. Seismologists of the United States of America consider it as one of the five biggest in human history. The magnitude of the shock, as calculated by them, was between 8.25 and 8.5, the highest ever calculated so far being 8.5. Reports of damage from North and East Assam which gradually came through the press show that an area nearly 15,000 square miles in North and East Assam including sub-divisions of North Lakhimpur, Dibrugarh, Jorhat, Tinsukhia, Sadiya and Sibsagar and the tribal areas of Abhor and Mishmi hills have suffered heavy damage. The loss of property in these areas has been stated to be nearly 10 crores of rupees. Fortunately the earthquake occurred at a time when people were awake and hence the loss of life has been very small in comparison with the magnitude of the shock.

The earthquake was accompanied with all the usual surface effects. Large fissures in the

ground on an extensive scale have been reported from the affected areas through which enormous quantities of sand and water have been forced out, thereby spoiling the standing crops in the fields. In many places the ground has been reported to have subsided by several feet and a few swamps have been elevated. The natural drainage of the country has thus been affected. Railway tracks have been damaged around Dibrugarh and a few road and railway bridges are reported to have been rendered unusable. Landslides in the Abhor and Mishmi hills have occurred on a large scale, blocking innumerable small streams which in due course will give way and cause floods in their lower courses. Some big rivers like Dihang and Subansari were also blocked by large land slides. These artificial barriers have now burst and the water stored up is causing floods in the river Brahmaputra.

The shock was felt throughout North-East India, as far as Banaras to the west. It is also reported to have been felt at Rangoon in the south.

DETERMINATION OF THE EPICENTRE OF THE EARTHQUAKE

The epicentre of the shock was determined by the Seismological Observatory at Poona with the help of data obtained from the Indian seismological stations at Bombay, Calcutta,

Hyderabad, Kodaikanal and New Delhi. The Observatory at Poona is equipped with the latest types of seismographs which include the Benioff vertical seismograph, the Sprengnether electromagnetic horizontal component seismograph, the I. Met. D. pattern torsion seismograph and the Milne-Shaw seismograph. The other Indian observatories are mostly equipped with Milne-Shaw seismographs, the I. Met. D. pattern torsion seismograph and the Omori-Ewing seismographs. Poona seismograms of

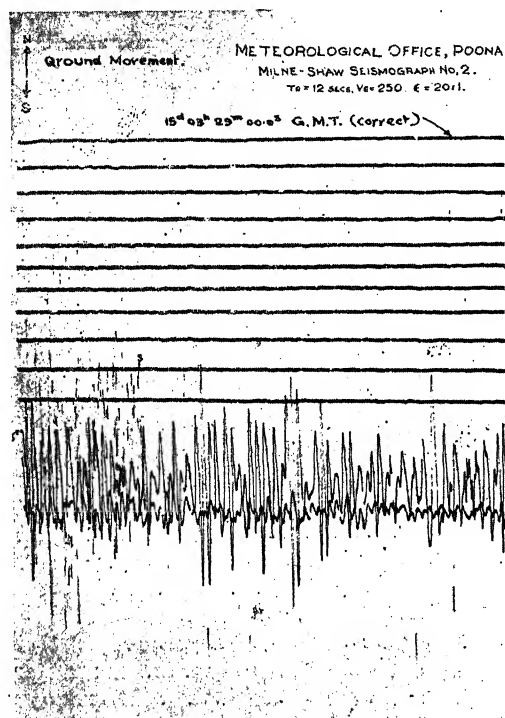


FIG. 1

the earthquake are shown in Figs. 1 and 2. Relevant phases which can clearly be distinguished are also shown. In this connection, it may be mentioned that due to the violence of the shock only the preliminary phases, and the beginning of the secondary phases could be recorded at most of the Indian stations. The surface waves which are the largest in amplitude, and which are mainly responsible for causing damage at places away from the epicentre, could not be recorded by any of the sensitive seismographs.

The corrected times of arrival of the P and S phases of the shock at the Indian seismological observatories in G.M.T. and the distances of the epicentre from them are given in Table I.

With the help of the data the epicentre

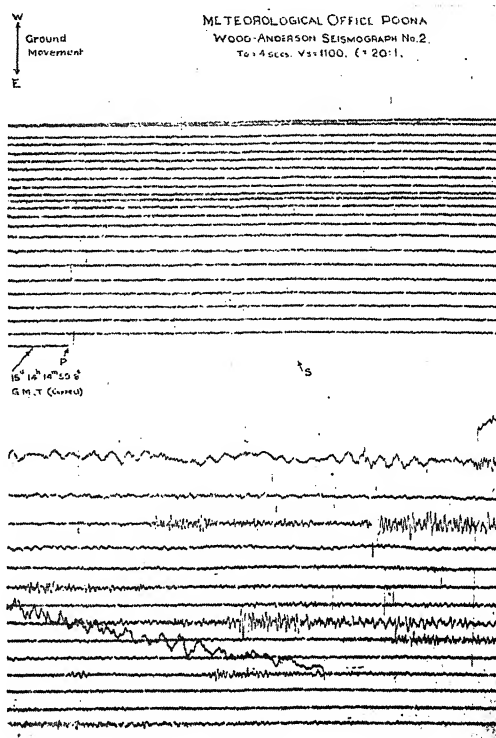


FIG. 2

TABLE I

Station	P			S			Distance from origin (in miles)
	h	m	s	h	m	s	
Bombay	14	14	48	..	..	..	1690
Calcutta	14	11	50	..	..	..	690
Hyderabad	14	14	05	..	..	..	1400
Kodaikanal	14	15	03	..	..	..	1840
New Delhi	14	13	26	..	..	..	1200
Poona	14	14	36	14	18	48	1630

of the shock was located at Lat. 29° N. and Long. 97° E., about 30 miles from the north-east border of Assam. The origin time of the shock was calculated as $15^{\text{h}} 14^{\text{m}} 23^{\text{s}}$ I.S.T. or $14^{\text{h}} 09^{\text{m}} 23^{\text{s}}$ G.M.T. The reported time of arrival of the S phase by the Indian observatories was not found to agree closely because of the difficulty in recognizing the S phase clearly, due to its getting mixed up with the coda of the main shock and the vibrations of the subsequent after-shocks. In calculating the epicentre, the times of arrival of the P and S phases at Poona and the time of arrival of the P phase at the other observatories could only be taken into

consideration. The determination of the epicentre is, however, in good agreement with that of the Coast and Geodetic Survey of the United States of America who have located it provisionally at Lat. $28\frac{1}{2}^{\circ}$ N. and Long. 97° E. near India, Burma, China Border.

The earthquake was followed as usual by a number of after-shocks which are still continuing in the affected region. Some of the after-shocks have been fairly strong and have caused further damage in the affected region. The after-shocks are originating from a large region around the epicentre, but mainly to the north and west of it.

NATURE OF THE SHOCK

A perusal of the seismograms shows that large surface waves were recorded at all distant stations showing that the origin of the earthquake is not deep seated and is confined within a few miles below the earth's surface. The nature of the damage with respect to the position of the epicentre also corroborates the same. The question has been raised as to whether the origin of the earthquake could be attributed to a volcano which had been lying dormant. A study of a number of earthquakes of volcanic origin in Japan shows that local earthquakes are felt in advance, which increase in frequency and intensity till the eruption of the volcano and then decrease rapidly afterwards. Also earthquakes of volcanic origin are shallow and their destructive effects are confined to within a few miles of the volcano and they are not recorded by seismographs beyond 50 to 100 miles. Even the tremendous volcanic explosion of Karakatoa Island in 1893 did not produce any noticeable seismic disturbance a hundred miles away.

In the case of the present earthquake destruction has been caused at distances of 150 to 200 miles, it has been recorded by seismographs all over the world, it was not preceded by any noticeable shock, and was followed by a large number of after-shocks, which are still continuing. It is therefore clear that the present great earthquake cannot be due to a volcano and is of purely tectonic origin. Its ultimate causes are linked up with the geological history of the formation of the great Himalayan mountains which are undergoing changes and are said to be still rising.

EARTHQUAKES IN ASSAM

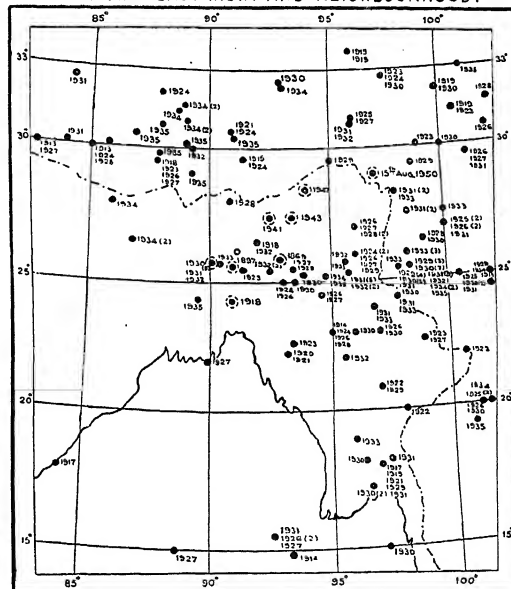
Not much is known about the earlier seismic history of Assam. This is due not to the absence of earthquakes in that region but to lack of information from these areas in earlier times. A fairly good account of the destructive

earthquakes which occurred in Assam is available from about the middle of the 19th century. R. D. Oldham did pioneer work in seismology and laid the foundation of seismological work in India.

Geologically, the region now called the State of Assam has been regarded as very unstable. As a matter of fact, Montessus de Ballore has called it as one of the most unstable regions in the world. It is therefore no wonder that this region has been the scene of nearly a dozen major earthquakes during the last century. These include the great Assam earthquake of 12th June 1897, which is regarded as the greatest earthquake in human history.

In Fig. 3 the epicentres of the earthquakes in Assam and the surrounding areas from

EPICENTRES OF EARTHQUAKES
IN NORTH AND EAST INDIA AND NEIGHBOURHOOD.



● Epicentres of earthquakes between 1913 and 1935
○ Epicentres of destructive earthquakes in Assam between 1869 and 1950
Years of occurrence of earthquakes are indicated against the epicentres
Figures in brackets denote the number of earthquakes in that year.

FIG. 3

1913-35 are plotted along with the year of occurrence. A list of destructive earthquakes in Assam with brief descriptions from 1869 to 1950 is given below, and the epicentres are also shown in Fig. 3.

LIST OF IMPORTANT EARTHQUAKES IN ASSAM

1. 1869, January 10. Assam (Cachar). Felt over an area of 250,000 sq. miles, the epicentre being on the north-east side of the Shillong plateau. Earth fissures and sand craters were very abundant.

2. 1897, June 12. Assam. Probably the greatest earthquake that has occurred anywhere during historic times. Felt over an area of 1,750,000 sq. miles with the epicentre in the Shillong plateau. Destruction of stone buildings almost universal in Shillong, Goalpara, Gauhati, Nowgong and Sylhet. Calcutta was seriously affected. About 1,600 lives lost. Followed by a great train of after-shocks continuing for 10 years.

3. 1918, July 8. Srimangal (Assam). Many tea estates ruined. Epicentre $3\frac{1}{2}$ miles south of Srimangal on an Alluvial tract. Felt over an area of 800,000 sq. miles. Sympathetic shocks off the Madras and Arakan Coast.

4. 1923, September 9. Epicentre Lat. $25^{\circ}5'N$. and Long. $91^{\circ}5'E$. southwest of Assam. Some damage to structures near epicentral region over West Assam and northern part of East Bengal. Felt over Assam, Bengal, East Bihar and East Chota Nagpur.

5. 1930, July 3. Epicentre $25^{\circ}8'N$, $90^{\circ}2'E$. Dhubri, Assam, near north-western end of the Garo hills. Felt over an area of about 350,000

sq. miles. No loss of life but a few slightly injured. Followed by a large number of after-shocks.

6. 1932, August 14. Epicentre $25^{\circ}8'N$, $95^{\circ}7'E$. in N.W. Burma. Focal depth about 130 kms. Semi-destructive near the epicentral region and some damage over eastern part of North-East Assam. Felt over Assam, Bengal and North Burma.

7. 1941, January 21. Epicentre $27^{\circ}5'N$, $92^{\circ}5'E$. in North Assam. Felt over Assam and North and East Bengal. Some damage near the epicentre.

8. 1943, October 23. Epicentre $27^{\circ}5'N$, $93^{\circ}5'E$. in Assam. Destructive over North-East Assam and minor damage over northern part of Assam. Felt over Assam, Bengal, and major parts of Bihar and North-East Orissa.

9. 1947, July 29. Epicentre $28^{\circ}5'N$, $94^{\circ}E$. about 100 miles north-west of Dibrugarh. Damage to buildings in parts of North-East Assam. Felt over Assam, in Bengal up to Calcutta and in Bihar up to Purnea.

V. V. SOHONI.

NUFFIELD FOUNDATION TRAVELLING FELLOWSHIP AWARDS TO INDIAN GRADUATES

THE Nuffield Foundation, with the object of advancing the interests of India as a whole and further strengthening the academic ties between India and the United Kingdom, has decided to make available to India five Travelling Fellowships for the year from 1951-52. An Advisory Committee in India has been appointed by the Foundation to advise them on the administration of the scheme, consisting of Shri. Gaganvihari L. Mehta, Member, Planning Commission (Chairman), Shri. S. Varadachariar, Sir C. V. Raman and Shri. J. J. Ghandy. It has been decided to award the Fellowships for the year 1951-52 in the following subjects:

Two Fellowships in Medical Sciences, preference being given to candidates wishing to study: (1) Physiology or Bacteriology, and (2) Industrial Medicine or Public Health; one Fellowship in Engineering, preference being given to candidates wishing to study Electrical Engineering (Generation or Distribution); one Fellowship in Natural Sciences, preference being given to candidates wishing to study Plant Genetics or Soil Science, and one Fellowship in Social Sciences, preference being given to candidates wishing to study Industrial Relations or Personnel Management, and Agricultural Economics.

The purpose of the Fellowships is to enable Indian graduates of outstanding ability to gain experience and training in the United King-

dom in their chosen fields, and to make contact with scholars working in those fields, with a view to the Fellows equipping themselves to take up senior posts in research and teaching in India.

The candidates, men or women, must be Indian nationals, normally between the ages of 25 and 40 years, and must be university graduates holding, preferably, a Master's or Doctor's degree, and having subsequently had a year or more of teaching or research experience on the staff of a university or comparable institution.

It is estimated that the total value of an award (exclusive of travelling expenses) will be at the rate of from £770 to £890 a year (sterling), according to individual circumstances. In addition, the Foundation will pay the travelling expenses to and from the United Kingdom of a Fellow's wife, if he is married at the time he makes his application, in those cases in which the Advisory Committee agrees to a Fellow being accompanied by his wife.

Applications for Fellowships to begin in 1951 should be submitted not later than the 31st March, 1951, to the Secretary, Nuffield Foundation Indian Advisory Committee, c/o Planning Commission, Government House, New Delhi, from whom copies of the form of application may be obtained.

A PAPHYROGRAPHIC MICRO-METHOD FOR A DETERMINATION OF THE ORGANIC ACID MAKE-UP OF FERMENTED BEERS

V. S. GOVINDARAJAN AND M. SREENIVASAYA

(Section of Fermentation Technology, Indian Institute of Science, Bangalore..3)

IN the course of our studies on the fermentative production of organic acids by various types and strains of fungi, maintained in the National Collection of Type Cultures, India, we were confronted with the problem not only of screening them with respect to their overall acid-producing capacity, but also of determining the organic acid make-up of the beer obtained by fermenting a standard sugar medium with each one of the fungal cultures.

The encouraging success which attended our studies on the papyrographic separation and characterisation of amino acids in micro quantities of protein hydrolysates¹ suggested the possibility of adapting this technique for a study of organic acids in fermented beers.

Preliminary experiments revealed that unlike amino acids, organic acids when run on the phase-pairs like water/*n*-butanol, were found to leave long diffuse tails behind the heads and the excursions were found to decrease with a fall in the concentration of the acids in the original solution. Lugg and Overell^{2,3} attribute these effects to the ionisation of the acids in the aqueous phase and their adsorption by the filter paper. They have worked out the conditions under which discrete separations of organic acids could be secured, by incorporating a volatile acid in the mobile phase, which suppresses the ionisation of the other acids and displaces them from the filter paper by competitive adsorption. Acetic and formic acids have been employed as the volatile constituent of the mobile phase. In our studies we have adopted this modification to a micro-scale with excellent results.

EXPERIMENTAL

For single samples, the test tube micro-technique described earlier¹ was followed. When, however, a number of samples had to be analysed, as for instance, when a comparative study of the organic acid make-up of beers produced by different types of fungi, had to be made, the samples were simultaneously run on the same sheet of paper under identical conditions. This was accomplished by spotting the different samples on the filter paper, which, after drying and rolling into a cylinder, could be made to stand without any support. The

vessel used consists of an ordinary cylindrical diet jar (10 cm. dia \times 20 cm. ht.) provided with a ground-glass cover, which could be sealed airtight by means of an adhesive tape. The solvent was prepared by shaking up equal volumes of distilled water, *n*-butanol and an adequate amount of acetic acid to yield initially a 2-3 moles solution in the aqueous phase. The phases separate within a short time.

The aqueous phase is placed at the bottom of the jar while the butanol-acetic phase is kept in a petri-dish cover placed at the bottom. The filter paper (19 cm. \times 18 cm.) was spotted with the test samples at points 2 cm. apart and in a line about a centimetre high from the lower edge of the paper. Quantities of the test beer varying from 0.001 to 0.005 ml. are delivered on to the spot by means of capillary pipettes. Care is taken to see that the diameter of the spot does not exceed 3-4 mm. After drying, the paper is rolled into a cylinder, "bosstitched" and hung for a couple of hours in the cylinder without dipping into the solvent; during this period, the filter paper gets itself saturated with the aqueous and volatile solvent vapours. The cylinder is then lowered into the centre of the petri dish containing the mobile phase. The run usually takes about five hours at the room temperature (24-25° C.) with the *n*-butanol-acetic as the mobile solvent.

After the run, the filter paper cylinder is air-dried over night and then passed through an oven at 60° C. for 5-10 minutes. The cylinder is then unrolled and treated with an alcoholic solution of brom-cresol green (40 mgm. per cent. in 95 per cent. alcohol) either by spraying or by dipping. The positions occupied by the acids are revealed as yellow spots against a greenish blue back-ground. (See Figs. 1 to 4 which represent faithful reproductions of the papyrograms.)

DISCUSSION

Fig. 1 shows that a mixture of the six acids, each of them being present at the level of 10 γ in the test spot, can be separated into discrete spots on the papyrogram. The excursion of a given acid is definitely influenced by the presence of another acid. It is, therefore, clear that the R_F values have little significance so far as the reading of the papyrograms of mixtures

are concerned. The relative positions occupied by the different acids from a mixture remain fortunately constant for any given phase pair. If, therefore, a known mixture of pure organic acids (reference mixture) is simultaneously papyrographed along with the test mixture (e.g., fermented beer) the spots of the reference mixture will serve to interpret the spots of the test fluid.

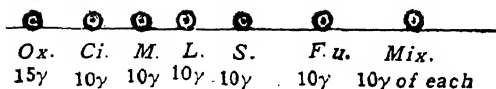
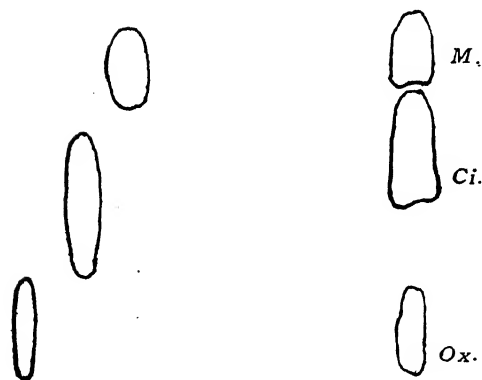


Fig. 1.

Papyrogram of Individual and Mixtures of Organic Acids. Abbreviations: Ox. (Oxalic); Ci. (Citric); M. (Malic); L. (Lactic); S. (Succinic); Fu. (Fumaric).

Figs. 1 and 2 show that except for oxalic and citric acids which yield elongated spots, the other acids appear as circular spots. By keeping the size of the initial test spots nearly constant, it is easy to obtain a semiquantitative idea of the relative concentration of a given acid in the mixture, by comparing the size of

the acid spot with a series of standard reference spots (see Fig. 2) obtained by papyrographing known quantities of the acid under

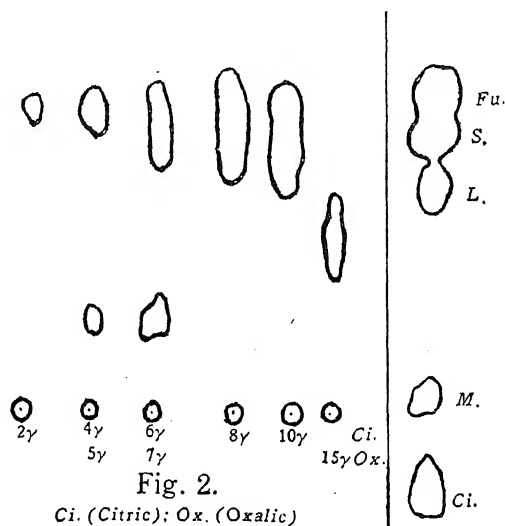


Fig. 2.

Ci. (Citric); Ox. (Oxalic)

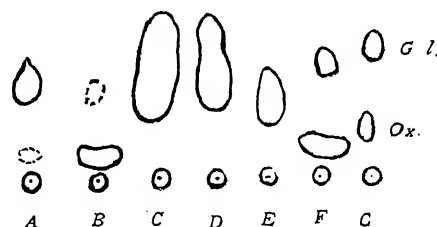


Fig. 3.

Papyrogram of Beers Fermented by Fungi.

A. oryzae—A: at initial pH 2 and B: at initial pH 6·8.

A. mucor—C: at initial pH 2 and D: at initial pH 6·8.

A. penicillium—E: at initial pH 2 and F: at initial pH 6·8. F: Reference Mixture of Organic Acids; G: (Gluconic).

the same conditions. Such estimations are obviously permissible and limited only to a certain well-defined range of acid concentrations. Quantities higher than 10–15 γ of each acid in the starting spot introduce complications in this micro-method. Lactic, succinic and fumaric acids, whose spots are closely situated, tend to merge into a continuous spot but remain distinctly discernible by the bulbular form of the spot.

Overloading the test spot with a heavy concentration of the mixture, will result in a continuous patch; the presence of a relatively high concentration of a single acid in the test mixture will give an elongated spot enveloping the spots produced by the acids which occupy

the nearby positions. This is illustrated in Fig. 4 where the beer fermented by a strain of *Aspergillus niger*, a high citric acid yielder, is papyrographed. The sample contains about 70 mgm. of citric acid per ml. of the beer, and 0.001 ml. of the beer was spotted. The citric acid spot is seen to cover the malic acid position also.

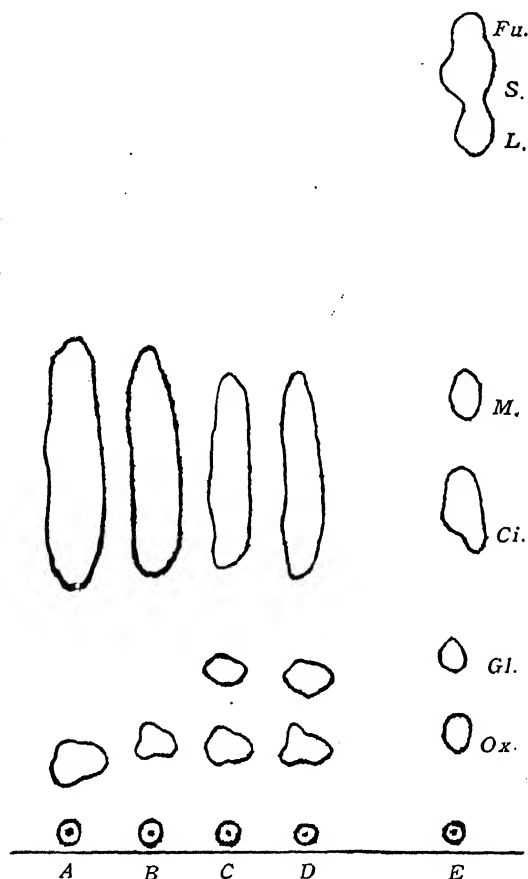


Fig. 4.

Papyrogram of Beer Fermented by *A. niger* 46-11.

A and B: with an initial pH 2.

C and D: with an initial pH 6.8.

E: Reference Mixture.

At the moment, the taxonomic classification of fungi is largely based on morphology while in the case of bacteria and yeasts, the classification takes into account the bio-chemical activities of the organisms. The fermentability of different types of sugars, for instance, has been extensively employed for the characterisation of bacteria and particularly yeasts. The

bio-chemical performance of fungi as a factor in their characterisation has not been extensively recognised probably because of the lack of suitable, reproducible and rapid methods of estimation. It is believed that the acid-producing capacity both in its qualitative and quantitative aspects might serve to characterise certain groups of fungi and distinguish certain strains of a particular type of organism. The papyrographic method which we have developed for characterising the acids, might be one such method which has the merit of (a) rapidity, (b) reproducibility, (c) simplicity and elegance, (d) ease of manipulation and (e) adaptability to micro quantities.

We have explored this possibility, by taking a few types and strains of fungi, growing them in a standard medium and subjecting the resulting beers to a papyrographic analysis. Two different hydrogen-ion concentrations, pH 2.0 and pH 6.8 have been chosen for these studies. The results are presented in Figs. 3 and 4.

From a study of the position and intensity of the spots it was found that the strain of *A. niger* produces large quantities of citric acid and traces of oxalic and gluconic acids. Beers fermented at pH 6.8 contain a smaller quantity of citric acid while a definite increase in the quantity of oxalic acid and gluconic acids is indicated.

The penicillium yields appreciable amount of oxalic and traces of gluconic acids at the neutral pH while with initial acid pH only gluconic acid is obtained.

A. oryzae give appreciable quantities of gluconic acid with initial acid pH and appreciable quantity of oxalic acid and traces of gluconic acid with the initial pH at 6.8, while the mucor has been found to form gluconic acid in appreciable amounts at both the pH. These results have clearly demonstrated that a considerable amount of data with respect to the acid-producing capacity of fungi could be obtained by this simple and elegant method of analysis. As suggested by Lugg and Overell,^{2,3} the spots could be excised, the acid extracted by steeping them in water and titrated. We can thus obtain a quantitative data.

The applications of this method are many; it offers a convenient method for making a comparative study of the acid-producing efficiency of the various mutants resulting by the irradiation or chemical treatment of a given fungus. The variation in the organic acid make-up of beers fermented under different experimental conditions—effect of temperatures, pH,

trace elements, atmospheres, concentration of various nutrients and forms of carbon and nitrogen—can be determined.

SUMMARY

A papyrographic micro-method for the separation, characterisation and semi-quantitative determination of the non-volatile organic acids in a mixture of them, is described.

The method is characterised by its simplicity, elegance, rapidity and ease of manipulation and has been shown to be adaptable to micro quantities of test samples.

The applicability of this method for a determination of the organic acid make-up of beers fermented by fungi has been demonstrated. The employment of this method as a helpful routine for a taxonomic characterisation of fungi, for evaluating the comparative acid-producing efficiency of different types, strains and mutants of fungi, and for a study of the

optimum conditions favouring the production of a given acid, is suggested.

Further, the method offers possibilities in the detection of intermediates⁴ and new acids formed during fermentation of carbohydrates just as the papyrographic method helped in the detection of new amino acids.

Our grateful thanks are due to the Council of Scientific and Industrial Research for financing the scheme on National Collection of Type Cultures of which this work forms a part. Our sincere thanks are also due to the Director for his kind interest.

1. Govindarajun, V. S., and Sreenivasaya, M., *Curr. Sci.*, 1950, **19**, 39. 2. Lugg, J. W. H., and Overell, B. T., *Nature*, 1947, **160**, 87. 3. —, *Aust. J. Sci. Res.*, 1948, **1A**, 98. 4. *Added in proof*: Use of buffered solvent and application to study of path of carbon in photosynthesis in given by Benson, A. A., *et. al. J. Amer. Chem. Soc.*, 1950, 72, 1710.

CENTRAL GLASS AND CERAMIC RESEARCH INSTITUTE

THE Central Glass and Ceramic Research Institute which was opened by the Hon'ble Dr. B. C. Roy, Chief Minister of West Bengal, during the last week of August at Calcutta, constitutes the fourth in the chain of National Laboratories and will satisfy a longfelt need. Even in 1918, the Indian Industrial Commission had recommended the setting up of such an Institute. During World War II, the need for the Institute was felt even more acutely. In 1942, the Government of India approved the establishment of the Institute and a Committee with Dr. S. S. Bhatnagar, Director, Scientific and Industrial Research, as Chairman, was appointed to prepare the plans. The proposals of the Committee were approved by the Governing Body of the Council of Scientific and Industrial Research in 1944 and a sum of Rs. 12 lakhs was sanctioned towards capital expenditure. The construction of the technological block commenced in 1945 and technical work has been going on there since 1948. But it was only in December 1945 that the late Shri. Ardesir Dalal, the then Member of the Viceroy's Executive Council for Planning and Development, laid the foundation-stone of the main building. Actual construction was, however, undertaken only after additional funds were sanctioned in September 1948. The Institute will conduct fundamental research having a bearing on the different branches of glass and ceramics. Its other functions will be

testing and standardisation, technical assistance to the glass and ceramics industry, dissemination of information and training of technologists for special work. The scope of its work includes research and investigation in glass, pottery and porcelain, enamels and refractories.

Apart from fundamental research, an important function of the Institute will be to render technical help to the industry in the improvement of the quality of products and to induce the industry, by demonstrating the benefits of scientific processes, to utilize and adopt improved techniques in works operations. In the course of time, the Institute will encourage the factories to send their workers for short training courses so that they may apply the knowledge so gained in manufacturing operations. Research staff will also be sent to visit factories in order that they may acquire factory experience.

The Institute will work in collaboration with industry, universities, other research organisations and Government departments for the collection of data and the dissemination of technical information. For this purpose, the Institute will also maintain a library for the use of workers and will organise a museum where a wide collection of finished articles, samples of raw materials in various regions, processed raw materials and other items of interest to the industry, will be displayed.

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ON THE TEMPERATURE DEPENDENCE OF COUNTER CHARACTERISTICS IN SELF-QUENCHING G. M. COUNTERS

In a previous communication the author¹ had reported about the temperature dependence of counting rate vs. voltage curves in self-quenching G. M. Counters with external (denoted as A) and internal (denoted as B) cathodes within the temperature range 9°-60° C. It was shown that the plateau disappeared at lower temperatures while at higher temperatures (within the range investigated) there was

an increase in plateau slope together with a decrease in useful plateau range.

In a private communication to the author Mr. J. L. Putman* pointed out that the effect of temperature on the characteristic curve of a Geiger Counter may take either or both of the two forms:

- An increase (or sometimes a decrease) in the slope of the plateau as the temperature is raised;
- A progressive shift of the plateau bodily towards higher operating potentials as the temperature is raised;

and remarked that both the effects are irreversible and a counter does not at once revert to normal after cooling down. Also, that the relative magnitude of effects (a) and (b) were different in counters of different types, and these permanent effects occurred at rather higher temperatures (around 100°C.) than reported in my previous paper.

In order to observe the type of effects suggested by Mr. Putman, counter B of the previous communication was successively raised to higher temperatures through 20° steps (upto 180°C.) in a thermostatically controlled electric furnace ($\pm 0.5^\circ\text{C}.$) and the counting rate-voltage curves obtained at different temperatures. The counter remained at each of the higher temperatures for about 2 to 3 hours and after each heating it was slowly brought to the room temperature in about half an hour and the characteristic curve obtained again. Some of the curves are given in Fig. 1.

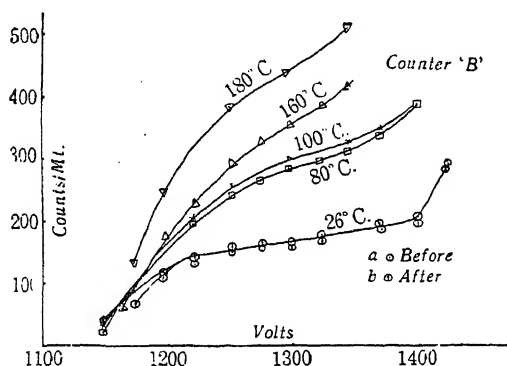


FIG. 1. Showing the counting rate-voltage curves at different temperatures. Two sets of points for the curve at 26°C. are (a) before the counter was put to test for this series of temperatures and (b) after this series was completed and the counter brought to the above temperature after 180°C. test. Curves obtained at 26°C. after each heating coincide with the given one and have been left.

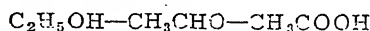
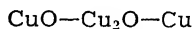
It is found that even after the counter has been heated to 180°C., it regains its original characteristics exactly and immediately except for a slight permanent increase in the starting voltage (which appeared after 160°C.) which might be due to a slight increase in pressure inside the counter as some of the adsorbed gases might come out at higher temperatures. It is also seen that the plateau has disappeared and there seems to be a large increase in the counting rate at higher temperatures. Visual observations on the oscilloscope screen showed practically no change in the height of the pulse,

though multiple pulses appeared more frequently and with greater multiplicity at higher temperatures.

Thus, in our particular case, the effects mentioned by Mr. Putman do not occur. However, Holt (Atomic Energy Research Establishment, Harwell, England) has obtained some results on commercial counters filled with argon-alcohol mixture. For instance,

- (i) The G.E.C. Type GM₁ counter had relatively little effect, showing only a general increase in the plateau level as the temperature was raised from 19-30°C., followed by a drop to the previous value at about 50°C., with little further change to 100°C.
- (ii) The G.E.C. Type GM₂ of a similar shape but baked out differently showed a change of plateau position as for example, 1080-1340 volts at 11°C., 1080-1440 volts at 20°C., 1220-1500 volts at 45°C., 1280-1550 volts at 98°C.
- (iii) An Eck and Krebs' silver cathode counter showed decrease in plateau length as the temperature was raised from 11-48°C. and then an increase in length upto 90°C. at least. The threshold was not affected.
- (iv) An all tools counter (B.L. No. 19) had a plateau from 760-860 at 16°C., from 800-920 at 30°C. and from 860-1000 volts at 49°C. Above that the threshold voltage showed little change, but the general level of the plateau increased being about 10 per cent. higher at 68°C.
- (v) A cinema Television GM₁ (copper cathode) counter did not come back to its original characteristics even after 24 hours (heated to 70°C.), the threshold remaining unaltered.

Holt² found these results to depend on the type of counter and not on the particular sample of the counter being used. Thus from the above discussion it appears that the temperature effect is different in different counters and that it must depend on the nature of the cathode. In our case, however, with oxidized copper cathode, the following change may occur at higher temperatures:



i.e., the alcohol finally got reduced to acetic acid and copper oxide (CuO) to cuprous oxide (Cu₂O) and then to copper. It was observed that some portions of the cathode turned pinkish from the original black, showing the occurrence of above type of reaction. Prolonged heating

should, therefore, show some effect on the life and properties of the counter.

Hence it seems necessary to test counters for their temperature dependence before using them in any standard work, especially when the counters are to pass through varying conditions of temperature, and as a precautionary measure to use a multi-vibrator circuit³ to eliminate any such effects.

The author is grateful to Dr. H. R. Sarna, Director of the East Punjab University Physics Laboratories, Government College, Hoshiarpur, for his kind encouragement and facilities provided for this work.

E. P. Univ. Physics Labs., OM PARKASH.
Government College,
Hoshiarpur,
East Punjab (India),
May 24, 1950.

1. Om Parkash, *Phys Rev.*, 1949, **76**, 568. 2. Holt, F. R., "Private Communication." 3. Putman, J. L., *Proc. Phys. Soc. Lond.*, 1948, **61**, 312.

* The author feels grateful to Mr. J. L. Putman for the information supplied. He is also thankful to Mr. F. R. Holt of the Atomic Energy Establishment, Harwell (England), who sent some of the data mentioned in this paper.

"JOSHI EFFECT" ^{1,2,3,4} IN IODINE VAPOUR UNDER X-RAYS

JOSHI⁵ found a 17 per cent. decrease of the discharge current in chlorine consequent on irradiation with X-rays—a very powerful means of ionisation. He claims that such a remarkable behaviour has not been observed hitherto in the literature of the X-ray phenomenon. Hence it was of interest to extend these obser-

vations to iodine vapour. Out of numerous sets taken in these Laboratories [using a glass ozoniser of the Siemen's type and observing the current by a reflection type galvanometer (Gambrell) actuated by a Germanium Crystal Diode 1 N 34 Sylvania], one is reproduced below (see table).

The following important results emerge from the observations.

1. Joshi Effect, the almost instantaneous and reversible photo-diminution of electrical conductivity, is not observed on irradiation with X-rays. A photo-increase, i.e., a + effect, has been observed.

2. The conductivity contributed by X-rays remains unaffected when the ozoniser is exposed simultaneously to X-rays, and white light. % Δ_i recorded in the "Mixture" column is approximately an algebraic sum of % Δ_i , recorded under X-rays and the white, e.g., at .4 KV, the corresponding effects with X-rays, white and Mixture are +25, -50 and -25 respectively.

The result No. (1) is the normal behaviour of the vapour on account of intense ionising properties of X-rays though apparently in direct contradiction to Joshi's findings⁵ in chlorine. The most significant result is illustrated under (2) and can find a very easy explanation on R. Prasad's views⁶ of the Joshi Effect, which suggest that the production of Joshi Effect originates from the dielectric component of the Total Current; the ionic or ohmic part of the discharge current is not affected by light. The X-rays contribute to increase the ohmic part of the current, which is not appreciably susceptible to light and hence the result. But Prasad's views are negated by overwhelming results which are in accord with

Potential in KV (r. m. s.) 50 cycles	Current in dark i_D	X-rays irradiation (Discharge type bulb)				Whitelight irradiation 100W-230 lamp			"Mixture" Simultaneous irradiation		
		Current under irradiation i_L	$i_D - i_L = \Delta i$	$\frac{\Delta i}{i_D} \cdot 100 = \% \Delta i$		i_L	$i_D - i_L = \Delta i$	$\% \Delta i$	i_L	Δi	$\% \Delta i$
.3	1	3.5	2.5	+250		.5	.5	-50	3.5	2.5	+250
.35	4	7	3	+75		2	2	-50	5	1	+25
.4	8	10	2	+25		4	4	-50	6	2	-25
.45	11	13	2	+19		6	5	-45	8.5	2.5	-22.7
.5	14.5	17	2.5	+16		10	4.5	-31	12	2.5	-17.1
.6	21.5	23.5	2	+9		20.5	1	-5	22	.5	+2.3
.75	26	37	1	+3		35	1	-3	36.5	.5	+1.3
.9	56	58	2	+3.5		55.5	.5	-.9	56	0	0
1	75	78	3	+4		75	0	0	78	3	+4
1.25	151	156	5	+3.3		151	0	0	156	5	+3.3

Joshi's views, that the ohmic part of the discharge current is the main seat of the phenomenon.^{7,8,9}

The result can be interpreted on Joshi's Theory, supported by the authors' views on the 'Velocity Spectrum' of the emitted photo-electrons from the adsorption layer, when exposed to radiations. Joshi's Theory contemplates three stages, viz., (i) an adsorption-like boundary layer is formed on the electrode surface under the applied field, (ii) photo-electric emission occurs from the layer and (iii) the photo-electrons are captured by the excited atoms and molecules to form slow-moving negative ions and produce the observed photo-diminution, as a space charge effect. When a radiation falls on the adsorbed layer, photo-electrons of various velocities (Velocity Spectrum) ranging from 0 and guillotined at

$v = \sqrt{\frac{h\nu}{2m}}$ are emitted. These electrons are captured by the excited atoms which are themselves under various states of excitation (including the state of ionisation) at a particular exciting potential. Since atoms under different states of excitation have different electron affinity, the probability of all electrons being captured is maximum, if electrons with various velocities are emitted out from the adsorbed layer (subject to the nature, pressure, etc., of the gas) and hence the saturation-like effect for the white light.

In the present investigation, these photo-electrons bring about a certain decrease, when the ozoniser is exposed to white light. Similarly when the ozoniser is exposed to X-rays, a photo-increase of conductivity occurs due to intense ionisation of the bulk of the gas. The X-rays may also simultaneously emit photo-electrons from the adsorbed layer but the velocity spectrum will be guillotined at a very high value, and so the chances of electron-capture (and hence Joshi Effect) are smaller. Hence the Joshi Effect due to X-rays is bound to be less and may completely be masked by the intense ionisation resulting in a +ve effect. The probability of electron capture is conditioned by many factors, such as nature, pressure of the vapour or gas under investigation, intensity of irradiation, velocities of photo-electrons, etc. By suitably choosing the pressure and nature of the gas it may be possible to observe a Joshi Effect as has been observed by Joshi in chlorine at 26 cm. pressure. When the ozoniser is flooded with the "Mixture", the X-rays do their job of increasing the conductivity while the white light does its own (produce a photo-

diminution), hence the last column is the algebraic sum of the other two columns.

Our grateful thanks are due to Prof. Joshi for his kind interest and guidance.

Holkar College Labs., A. P. SAXENA.
Indore (Madhya Bharat), P. K. KARMALKAR.
June 12, 1950.

1. Joshi, *Curr. Sci.*, 1939, **8**, 48. 2 —, *Pres. Address, Chem. Sec. Ind. Sci. Cong.*, 1943. 3. —, *B. II. U. Journal*, 1943, **8**, 99. 4. —, *Nature*, 1944, **154**, 147. 5. —, *Curr. Sci.*, 1944, **13**, 278. 6. Prasad, R., *Nature*, 1945, **155**, 362. 7. Joshi, *Curr. Sci.*, 1945, **14**, 67. 8. —, *Proc. Ind. Acad. Sci.*, 1945, **22A**, 293. 9. Tiwari and Prasad, *Curr. Sci.*, 1945, **14**, 229.

DIELECTRIC CONSTANTS OF CANE SUGAR

CANE sugar ($C_{12}H_{22}O_{11}$) belongs to the monoclinic spenoidal class. It has *b* axis as the symmetry axis, and the crystallographic *a* axis is inclined at $103^{\circ} 30'$ to the *c* axis. Angles in the (010) plane are taken positive when measured from *c* in the direction of the above obtuse angle. The optical ellipsoid has one of the principal axes inclined at $+66^{\circ} 30'$ to the *c* axis. One of the principal directions of the electric susceptibility coincides with *b* axis, while the other two in the (010) plane are inclined to the crystallographic axes.

The principal dielectric constants of cane sugar are determined using sections from perfectly transparent colourless crystals by the liquid-mixture method¹ at a frequency of 1.6 megacycles and are given below together with those of previous investigators.

	K_1	K_3	K_b	ϕ
Author ..	3.85	3.53	3.56	$+12^{\circ}$
Schmidt & Dubbert ² ..	3.46	3.16	3.32	$-58^{\circ} 7$

(ϕ is the angle between the direction of K_1 and *c* axis.)

In the direction -60° to *c*, the author observed the dielectric constant to be 3.58 whereas in the direction nearly perpendicular to the (001) plane, the value is 3.85.

The squares of refractive indices extrapolated to infinite wavelength from the visible region are 2.34, 2.42 and 2.44. Hence the mean atomic polarisation of cane sugar comes out to be 32.2 per cent. of the total polarisation. This high value of the percentage of atomic polarisation in the case of cane sugar compared to 10 per cent. or less in the case of hydrocarbons as benzene, toluene, hexane, etc., is

not surprising in view of the presence of OH radicals in the molecule. The OH radicals are known to cause additional polarisation and the effect of their presence can be seen by comparing the atomic polarisation of solid Benzene³ (C_6H_6)— $P_A \approx 3.4$, and of solid phenol⁴ (C_6H_5OH)— $P_A = 5.5$. Similarly when we pass from propane⁵ (C_3H_8) to glycerine⁶ [$C_3H_5(OH)_3$] it has been found that the atomic polarisation increases. In the case of tartrates such as dipotassium tartrate, sodium ammonium tartrate, etc., and of alcohols in the solid condition, the dielectric constants are much higher than the squares of refractive indices leading to high percentage of atomic polarisation, and the OH radicals are known to be partly responsible for it.

The author wishes to thank Shri. B. C. Joshi, Cane Sugar Research Institute, Ravalgaon, for supplying the crystals.

D. A. A. S. NARAYANA RAO.

Andhra University,
Waltair (S. India),
July 8, 1950.

1. *Proc. Ind. Acad. Sci.* 1947, 25A, 408. 2. *Lehrbuch der Kristall Physik* (Voigt), 1910, 459. 3. *Jour. Phy. Chem.*, 1930, 34, 2385. 4. *Jour. Amer. Chem. Soc.*, 1933, 55, 462. 5. *Ibid.*, 1933, 55, 453. 6. *Proc. Roy. Soc.*, 1936, 154A, 138.

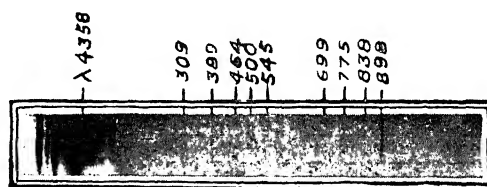
RAMAN SPECTRUM OF CADMIUM TUNGSTATE

VERY little work has been done so far on the Raman spectra of crystalline tungstates. The only reference in the literature on the subject is to a paper by Nisi¹ on the Raman spectrum of scheelite, $CaWO_4$. Recently, an artificially-grown single crystal of cadmium tungstate, supplied by the Linde Air Products Co., was made available to the author for studying its Raman spectrum. It was in the form of a square rod of size $20 \times 3 \times 3$ mm. and slightly yellowish in colour. The specimen was not quite transparent, as it had some inclusions in the middle. Its Raman spectrum taken with λ 4358 excitation from a water-cooled mercury arc and with a Fuess spectrograph is reproduced below. Although the specimen was found to be free from fluorescence, a more intense photograph of the Raman spectrum could not be obtained, since the scattering was very feeble. The recorded spectrum exhibits nine frequency shifts, the values of which are entered in Table I. Their positions have been marked in the figure. The degeneracies of ν_2 , ν_3

and ν_4 are completely removed in the spectrum of crystalline cadmium tungstate (see Table I),

TABLE I

Substance	ν_1	ν_2 (2)	ν_3 3	ν_4 (4)
Na_2WO_4 in Solution (2)	934	325	843	452
$CaWO_4$ Scheelite	909	332	852 835 795	400
$CdWO_4$	898	389 309	838 775 699	545 500 464



The Raman Spectrum of Cadmium Tungstate

indicating thereby that the symmetry of the crystal is very low. The lowering of the frequency of the symmetric oscillation ν_1 by about 35 cm^{-1} suggests that the influence of the cation on the WO_4 oscillation is considerable.

The author wishes to express his grateful thanks to Prof. R. S. Krishnan for his constant encouragement and guidance.

Physics Dept.,
Ind. Inst. of Science,
Bangalore 3,
August 22, 1950.

V. CHANDRASEKHARAN.

1. Nisi, *Zeman, Verhandelingen*, 1935, p. 261.
2. Venkateswaran, C. S., *Proc. Ind. Acad. Sci.*, A, 1938, 7, 144.

OCCURRENCE OF RADIO-ACTIVE COLUMBITE IN TRAVANCORE

LABORATORY tests on a grey black mineral which the author came across during his field investigations on a complex pegmatite at a place called Othara in Central Travancore, have revealed that it is columbite containing niobium as the major constituent element.

The physical properties of this mineral were observed to be as follows:—Cleavage: *rather distinct in one direction*; Fracture: *uneven, brittle*; Hardness: 6; Specific Gravity: 5.57; Lustre: *submetallic*; Streak: *black*. These agree fairly well with the properties of the columbite-tantalite series of isomorphous minerals. Since the lump of mineral under study

had only one or two partially-developed crystal faces, it has not been possible to observe as to which crystal system it belongs. For the time being, it has to be presumed that the crystal system is orthorhombic as is the case with all the members of the columbite-tantalite group.

Chemical analysis of the mineral has shown that tantalum, iron and manganese are the other important elements present in the mineral. Columbite and tantalite, as is well known, are the niobate and tantalate of iron and manganese respectively with the general formula $(\text{Fe, Mn})(\text{Nb, Ta})_2\text{O}_6$ and they pass by insensible gradations from normal columbite, the nearly pure niobate at one end of the series, to normal tantalite the almost pure tantalate at the other.¹ Their specific gravities also vary from 5.3 to 7.3 depending upon the percentage of niobium and tantalum in them. The specific gravity and chemical composition easily fix the place of the mineral under study, at the columbite end of the series. Quantitative chemical analysis is in progress.

The mineral has also been found to be radio-active. The detection and determination of its radio-activity was made by a sensitive α -ray electroscope² of the general pattern originally devised by C. T. R. Wilson³ in his investigation of the natural ionisation of gases, but modified to suit measurement of radio-activity of some of the feebly active mineral sands of Travancore, for which it was specially designed. A comparison of the activity of the mineral with that of a sample of known uranium content, under identical conditions, has given the percentage of uranium equivalent in the mineral as 0.25. The result is being checked by chemical methods.

The occurrence of columbite in Travancore is of some significance in that it is a new addition to the list of radio-active minerals found in the State. The occurrence in Travancore of a mineral belonging to the columbite-tantalite series has not been previously recorded.

The author takes this opportunity to express his grateful thanks to Mr. T. R. M. Lawrie, till recently Director of Mineral Survey and Research, University of Travancore, for his kind guidance and encouragement in the work. His thanks are also due to Mr. A. O. Mathai, Physics Department, University College, for permission to use the α -ray electroscope and for his kind co-operation.

The author wishes to record his great indebtedness to Dr. P. V. Nair, Professor of Applied Chemistry, University of Travancore, for valu-

able suggestions and advice throughout the work.

Div. of Min. Survey & Res., C. V. PAULOSE.
Central Research Institute,
Trivandrum,
June 16, 1950.

1. Dana, *Text Book of Mineralogy*, 1949, pp. 695-97,
2. Mathai, A. O., *Dissertation for M.Sc., University of Travancore*, 1943.
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OCCURRENCE OF ANDALUSITE NEAR MALLEGOWDANAHALLI (13°-22'; 77°-23') IN THE DODDABALLAPUR TALUK, BANGALORE DISTRICT

IN the course of the survey of the corundum-bearing rocks in the Bangalore District during the field season of 1949-50, an interesting outcrop of sericite quartzite containing a coarse brown-coloured mineral—later determined to be andalusite—was located at a place about 100 yards south of the corundum workings to the east of Mallegowdanahalli village in Doddaballapur taluk. In the present note, we have given the mineralogical characters of this mineral, while the chemical analysis remains to be done. Details relating to the mode of occurrence and origin of the mineral in this area are being worked out and a separate paper is proposed to be published elsewhere.

The mineral is orthorhombic and occurs in coarse-bladed and prismatic forms, some of the faces showing parallel striations. Colour is brown or reddish brown and the lustre is vitreous. The hardness is over 7 (quartz is scratched) and the specific gravity is 3.14. Prismatic cleavage is very pronounced and traces of basal cleavage are also seen. Broken fragments of the mineral show uneven fracture.

Under the microscope, the mineral shows uniform straight extinction and the colour is pale yellowish green to rose red. The following scheme of pleochroism and optical orientation is noticed:—

X = Pale rose red; deeper shade of red in thick sections.

Y and Z = Light greenish yellow.

Optical orientation 'c' = X.

The mineral is optically negative.

The above characters indicate that the mineral is andalusite. Mr. B. Rama Rao¹ has stated that some of the fine grained micaceous schists in the gneissic complex of Mysore contain andalusite, kyanite and sillimanite, but no specific

zones where andalusite is found have been recorded so far, in any of the publications of the Department. A reference to the occurrence of a brown mineral answering the characters of andalusite, in an area to the south of the present locality, is found in the field notebook of late Mr. P. Sampat Iyengar. This mineral (Z./596) has, however, been described by him as idocrase.

Mysore Geol. Dept., T. P. KRISHNACHAR.
Tumkur, C. SURYANARAYANA RAO.
July 8, 1950.

1. *Mys. Geol. Dept. Bull.*, No. 17, p. 51.

A NEW SPECIES OF AZOTOBACTER ISOLATED FROM THE ACID PEATS (KARI SOILS) OF TRAVANCORE- COCHIN

AZOTOBACTER is well known for its sensitivity to reaction. Its limiting reaction has now been fairly generally accepted as pH 5.8 to 6.0. Starkey¹ has reported the isolation of an acid-tolerant *Azotobacter* from the paddy soils of East Bengal. This, perhaps, is the only instance reported so far of the occurrence and isolation of such an organism. This author, however, has doubted "whether or not the acid-tolerant *Azotobacter* is widely distributed in soils or will develop in soils over a wide range of reaction still remains to be ascertained". Special media had to be used by him for the isolation of this *Azotobacter*, the growth of which became apparent only after several weeks of culturing.

In the present work, the author has isolated a similar acid-tolerant organism from Travancore acid (*Kari*) soils having a range of reaction from pH 2.5 to 4.5. It could be isolated on media commonly used for the isolation of *Azotobacter*. It has a size of 3.5-7 μ as against 0.5 to 1.2 \times 1.7-2.7 μ for *az. indicum*, Starkey and 5-6 to 2-3 μ for the other species. One characteristic feature which distinguishes it from the acid-tolerant *Az. indicum* Starkey is its good growth on media supplied with CaCO_3 . It grows equally well on media free from calcium carbonate. It develops well in nitrogen-free liquid and solid media from the acid limit pH 2.5 to pH 8.5 utilising mannite, sucrose, glucose and lactose. The organism fixed on an average 12 mgs. of nitrogen per gram of mannite. The organism is peritrichous, highly motile and diplococcoid.

The unusual tolerance of the new organism to extreme conditions of soil acidity and its

easy isolation differentiate it from any of the previously known species of *Azotobacter* and even from the acid-tolerant *Az. indicum*. Further details will be published elsewhere.

The author is grateful to the University of Travancore for the award of a special Research Scholarship which enabled him to carry out certain aspects of this investigation at the Indian Agricultural Research Institute, New Delhi, and to Dr. J. N. Mukerjee, Dr. N. D. Vyas and Mr. S. C. Biswas, of the Indian Agricultural Research Institute, for their kind interest and valuable advice. He is also indebted to Dr. P. V. Nair, Professor of Applied Chemistry, University of Travancore, for his kind interest and encouragement.

Div. of Applied Chemistry, N. SUBRAMONEY.
Central Research Institute,
Trivandrum,
August, 1950.

1. Starkey, *Trans. Inst. Soc. Soil Science*, 3rd commn., A, 1939.

EFFECT OF NICOTINE, QUINOLINE, 3-3'-DIPYRIDYL AND β -PICOLINE ON THE BIOSYNTHESIS OF NICOTINIC ACID IN ANIMALS

NICOTONIC acid can be easily prepared in the laboratory by the oxidation of nicotine, quinoline 3-3'-dipyridyl and β -picoline. The present investigation has been carried out to see whether the animals can utilise these compounds for the biosynthesis of nicotinic acid in their body. The effect of these compounds has been studied by estimating the changes in the urinary excretion of this growth factor after incorporating them with the basal diet.

The technique of the experiment was the same as reported in the previous investigation on riboflavin—the only difference being that nicotinic acid supplement of the previous diet was substituted by 10 μg of riboflavin. The nicotinic acid was estimated by the method of Swaminathan¹ using both the acid hydrolysis, and alkali hydrolysis with urea and the values obtained include nicotinamide, nicotinuric acid, and trigonelline along with nicotinamide methochloride and all the values are expressed as total nicotinic acid. Amyl alcohol was used to extract the colour produced by cyanogen bromide.

The table shows that except β -picoline, the other three compounds did not aid the biosynthesis of nicotinic acid showing that the rats cannot synthesise nicotinic acid from quinoline,

nicotine and 3-3'-dipyridyl. Since quino-
linic acid—the oxidation product of quinoline—
can easily help the biosynthesis of nicotinic
acid when fed to rats as observed by Ellinger
*et al.*² it is quite evident from the present re-
sults that the rats also cannot convert quinoline
to quino-
linic acid.

*Table showing the effect of feeding nicotine,
quinoline, 3-3'-dipyridyl and β -picoline on
the urinary excretion of nicotinic acid. (The
values indicate the average excretions in
 μ g per rat per day.)*

Diet and supplement	Urinary output of nicotinic acid in μ g
Basal diet	36.3
„ +5 mg. of nicotine	34.8
„ +5 mg. of quinoline	35.3
„ +5 mg. of 3-3'-dipyridyl	32.2
„ +5 mg. of β -picoline	89.3

The increased elimination ($2\frac{1}{2}$ times the
basal value) due to β -picoline suggests that
rats can oxidise those pyridine derivatives
which are substituted by the methyl group at
the side chain-oxidation taking place at the
side chain only. Ellinger *et al.*² have shown
that not only methyl but all alkyl substituted
pyridine derivatives are utilised by rats for the
production of nicotinamide methochloride. The
conversion of β -picoline to nicotinic acid can be
ranked with the oxidative detoxication mecha-
nism by which the benzene or toluene when
fed to rats was found to be excreted in the
urine as benzoic acid.

Biochem. & Nutri. Labs.,
Dacca University,
Dacca, Pakistan,
April 6, 1950.

H. N. DE.
P. DATTA, JR.

1. Swaminathan, M., *Ind. J. Med. Res.*, 1942, **30**,
537. 2. Ellinger, P., Fränkel, G., and Abdul Kader,
M. M., *Biochem. Jour.*, 1947, **41**, 559.

KINETICS OF ACETONE AND IODINE REACTION

HALOGENS have been widely used as agents to
study prototropy in ketonic and allied substan-
ces in their aqueous solutions.¹

Iodination of acetone was carried out by us
to study prototropy of acetone in dark in its
aqueous solution catalysed separately by differ-
ent organic and inorganic acids and their salts.

The reaction is of zero order with respect to

iodine in absence of the catalyst. It is of first
order with respect to both acetone and the acid
which is the catalyst used. The reaction was
of zero order with respect to iodine in pre-
sence of salts but in absence of the acid
catalyst.

In presence of the acid catalyst, the ketonic
form is converted to the enolic form which in
turn is iodinated. K follows the following
order:—

$\text{HCl} > \text{H}_2\text{SO}_4 > \text{H}_2\text{C}_2\text{O}_4 > \text{CH}_3\text{COOH}$. But
change in K takes place on addition of salts in
the following order:—

HCl $\text{NH}_4 > \text{K} > \text{Na} > \text{HCl}$
 H_2SO_4 $\text{H}_2\text{SO}_4 > \text{NH}_4 > \text{Na} > \text{K}$
 $\text{H}_2\text{C}_2\text{O}_4$ $\text{H}_2\text{C}_2\text{O}_4 > \text{NH}_4 > \text{K} > \text{Na}$
 CH_3COOH $\text{NH}_4 > \text{CH}_3\text{COOH} > \text{K} > \text{Na}$

In acetic acid specially, the buffered solutions
of its salts exert an influence on unbuffered
acetic acid as regards K with its definite dis-
sociation constant and hence the probable
change in value of E. The addition of sodium
and potassium acetates decreases the acid cata-
lysed reaction.

Anomalies were noted for K with ammonium
salts in the above cases. This is because NH_4
ion is both an acceptor and donor of electrons.
P. W. Robertson² observed that the rate of
iodine addition, in cases having salts contain-
ing electron attracting factor, decreases faster
as the electron attracting power increases.

Further work in this line is in progress.

Chemical Laboratories, A. K. BHATTACHARYA.
University of Saugar, S. M. WAKHALE.
Saugar, M. P.,
April 26, 1950.

1. Bell, R. B., and Tautram, A. D. S., *J. C. S.*, 1948,
370-4. 2. *J. C. S.*, 1945, 891-93.

SENSITIVITY OF PATCHOULI TO MANGANESE DEFICIENCY IN SOILS

In the course of a study on the influence of
minor elements on the growth of our crops, it
was observed that patchouli (*Pogastemon
patchouli*) exhibits characteristic deficiency
symptoms which appear to be related to man-
ganese deficiency. Spinach¹ and tobacco²
plants, among others, have been recognised as
being sensitive to deficiency of this and other
minor elements. Spinach and patchouli grown
in the soil under investigation developed chlo-
rotic leaves indicative of manganese deficiency.
In the early stages, there are yellow spots in
in the intervenal spaces towards the tip of the

Soil	Pn (KCl extract)	Total		Exchangeable		Reducible Mn	Total available Mn	N %	P ₂ O ₅ %	
		Mn	Fe	Mn	Fe					
		Parts per million								
Deficient	..	8.5	400	3920	48	52	12	60	0.118	1.92
Normal	..	8.0	375	7000	60	60	62	122	0.090	2.10

leaf and at the leaf edges, which as the growth proceeds widen out on either side of the veins and the mid-rib. At maturity, the whole leaf attains a yellow colour with only the mid-rib and veins remaining green.

In patchouli, as with spinach, the leaves are much thinner and the average leaf area smaller than that of the healthy leaves, the foliage also being sparse. In a nearby area where the adverse soil conditions do not prevail, both the types of plants grow in a normal manner producing healthy leaves.

The soils in the two areas were analysed for their content of manganese and other elements and the result are as shown in the table above.

Of the nutrients analysed, only the available manganese is found to be low in the deficient soil compared to the normal soil.

The normal and chlorotic leaves of the two plants gave the following analysis:

Leaves	Mn	Fe	P ₂ O ₅	N
	In dry material p.p.m.	In dry material %	In dry material %	In dry material %
Spinach (Healthy)	10.0	46.6	1.84	..
.. (Chlorotic)	7.5	21.2	1.08	..
Patchouli (Healthy)	12.5	42.5	0.87	2.25
.. (Chlorotic)	4.0	28.5	0.84	2.10

Marked differences are found in the manganese content of the leaves, the chlorotic leaves having a lower content of manganese than the healthy leaves. Differences in the iron content are also noted. The chlorotic symptoms are found to be cured in the young leaf by the application of manganese sulphate at 5-10 lbs. per acre in the form of solution.

Chemical Laboratories, S. R. LAKSHMIKANTA.
Agric. Res. Institute, S. V. GOVINDARAJAN.
Bangalore,
April 17, 1950.

POSITION OF DOUBLE BONDS IN THE ALIPHATIC SIDE CHAIN OF THE MONOPHENOL FROM COMMERCIAL CASHEW NUT SHELL LIQUID

THE monophenol obtained by vacuum distillation of either commercial raw cashew nut shell liquid or of solvent extracted liquid has been shown definitely to be a heterogeneous mixture¹ composed of molecules containing, in the straight 15 carbon aliphatic side chain in meta-position to the phenolic OH, one, two and possibly more double bonds, such that a statistical average of two double bonds per side chain is observed experimentally.

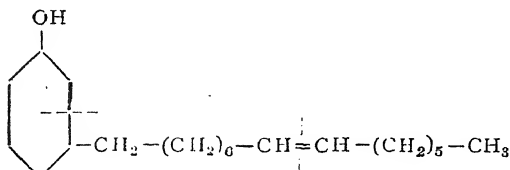
The single double bond in the monoolefinic component has been assigned by Sletzing and Dawson² the 8, 9 position in the side chain counting from the nucleus, on the basis of isolation of heptaldehyde from the products obtained from treatment of the monophenol with Prevost reagent and oxidation of the resulting glycol with periodic acid. This conclusion was later confirmed by synthetic methods by the same authors.³

Results obtained independently in this laboratory by a different method of oxidation furnish evidence not only to confirm the above structure for the monoolefinic component, but also to permit one to fix the relative positions of the double bonds in the diolefinic component.

Among the products of oxidation, with potassium permanganate in acetone solution, of the monophenol from vacuum distilled commercial liquid, acetic, valeric, heptylic, oxalic, azelaic and suberic acids have been isolated and identified. The methyl ether of the same monophenol, under identical conditions of oxidation, yielded acetic, valeric, heptylic, *m*-anisic, oxalic, and pimelic acids (pimelic acid alone needing further confirmation).

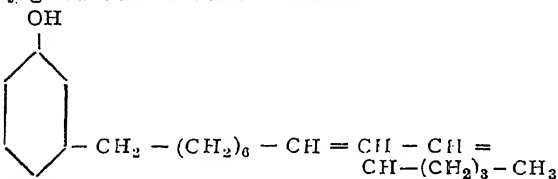
The presence, among oxidation products of the phenol, of heptylic and azelaic acids confirms the following structure for the monoolefinic component, proposed by Dawson and co-workers, the dotted lines indicating the cleavage points during oxidation,

1. Davies, *Agric. Progress*, 1939, **16**, 45. 2. McMurtey, J. R., *U. S. D. A. Tech. Bull.*, 1938, **612**, 30.



The breaking of the nucleus under the given oxidation conditions, seems to be made possible by the unsaturated side chain and the OH occupying the 1, 3 positions in the nucleus. The corresponding methyl ether of the monoolefinic component would be expected to break at the 1, 2 and 8, 9 positions of the side chain, giving *m*-anisic, pimelic and heptylic acids, as has experimentally been verified.

The isolation, in addition to the above acids, of valeric and oxalic acids in the oxidation products both of the phenol and its ether, suggests for the diolefinic component a conjugated double bond structure.



The fact that oxalic acid is found in both cases, and that its yield is qualitatively less in the case of the ether, seems to indicate that the oxalic acid from the ether must come almost exclusively from the conjugated double bond. Possibility of rearrangement prior to oxidation cannot absolutely be ruled out, to elucidate which further chemical and spectroscopic study is in progress; but the above evidence appears to be, for the moment, conclusive.

It is to be noted that the presence of acetic acid in the oxidation products of the phenol and its ether, may be due to oxidation of solvent acetone under alkaline condition progressively brought about during permanganate oxidation, and possibly also to the breaking of a particular and as yet unidentifiable double bond. As for the presence of suberic acid from the phenol alone, a definite explanation must await further investigation which is being actually conducted. Full details of the material here presented will be published elsewhere.

Dept. of Chemistry, V. J. PAUL.
Loyola College, L. M. YEDDANAPALLI.
Madras,
June 1, 1956.

1. cf. Previous letter by V. J. Paul, *et al.* 2. *J. Am. Chem. Soc.*, 1946, **68**, 345. 3. *J. Org. Chem.* 1949, **14**, 670 & 849.

DIRECT COMPUTATION OF ORIENTATION POLARISATION FROM DILUTE SOLUTION DATA

In a previous note¹ it was shown that the observed linearity of dielectric constant with concentration in dilute solutions of nonpolar solvents can be quantitatively interpreted on the basis of the Clausius-Mosotti expression for polarisation. Assuming the linear dependence of specific volume with concentration, it was found that

$$\alpha = \frac{\epsilon_{12} - \epsilon_1}{\omega_2} = \frac{3}{V_1 - p_1} \left\{ (p_2 - p_1) + \left(\frac{p_2 - p_1 - \beta}{V_1 - p_1} \right) p_1 \right\} \quad (1)$$

whence

$$p_2 = \frac{3\alpha V_1}{(\epsilon_1 + 2)^2} + (V_1 + \beta) \frac{\epsilon_1 - 1}{\epsilon_1 + 2} \quad (2)$$

Similarly on the basis of the Lorenz-Lorentz expression for electronic polarisation

$$p_E = \frac{n^2 - 1}{n^2 + 2} \cdot \frac{1}{d},$$

$$\gamma = \frac{n_{12}^2 - n_1^2}{\omega_2} = \frac{3}{V_1 - \epsilon p_1} \times \left\{ (\epsilon p_2 - \epsilon v_1) + \left(\frac{\epsilon p_2 - \epsilon p_1 - \beta}{V_1 - \epsilon p_1} \right) \epsilon p_1 \right\} \quad (8)$$

whence

$$\epsilon p_2 = \frac{3\gamma V_1}{(n_1^2 + 2)^2} + (V_1 + \beta) \frac{n_1^2 - 1}{n_1^2 + 2} \quad (4)$$

Combining (2) and (4)

$$\epsilon p_2 = (p_2 - \epsilon p_2) = 3V_1 \left\{ \frac{\alpha}{(\epsilon_1 + 2)^2} - \frac{\gamma}{(n_1^2 + 2)^2} \right\} + (V_1 + \beta) \left\{ \frac{3(\epsilon_1 - n_1^2)}{(\epsilon_1 + 2)(n_1^2 + 2)} \right\} \quad (5)$$

Thus if α , β and γ are experimentally determined, the orientation polarisation ϵp_2 and hence the dipole moment μ can be directly computed from equation (5) knowing the constants for the solvent ϵ_1 , n_1 and V_1 .

If $(\epsilon_1 - n_1^2)$ is small and hence ignored, equation (5) reduces to either

$$\epsilon p_2 = \frac{3V_1(\alpha - \gamma)}{(\epsilon_1 + 2)^2} \quad (6)$$

or

$$\epsilon p_2 = \frac{3V_1(\alpha - \gamma)}{(n_1^2 + 2)^2} \quad (7)$$

A noteworthy feature of equations (6) and (7) is that it is not at all necessary to know β , the concentration coefficient of density of solution, in order to calculate ϵp_2 . The data of Few and Smith² on aniline and its derivatives has been chosen to illustrate the relative merits of equations (5), (6) and (7). Values for α and β have been taken directly from Few and Smith's paper whereas γ has been evaluated as

the slope of the $n_{12}^2 - \omega_2$ plots which, in all cases, are straight lines.

		ϵp_2 by equation No.			
		γ	(5)	(6)	(7)
Aniline	..	0.238	47.64	47.15	47.78
(Benzene)	..			(47.65)	
Aniline	..	0.498	64.00	61.77	67.65
(Dioxane)	..			(64.19)	
Methyl-	..	0.202	57.26	56.82	57.19
(Benzene)	..			(57.39)	
Methyl-	..	0.454	70.29	67.45	73.87
(Dioxane)	..			(70.49)	
Dimethyl-	..	0.169	52.80	52.26	52.95
(Benzene)	..			(52.89)	
Dimethyl-	..	0.397	56.60	53.10	58.15
(Dioxane)	..			(56.58)	

The values computed by equation (5) agree very well with those of Few and Smith tabulated above in parenthesis ($\epsilon p_2 = p_2 - [R_n]$). For benzene solutions where $(\epsilon_1 - n_1^2)$ is very small equations (6) and (7) give values of ϵp_2 differing by not more than 1 per cent. from the values calculated by equation (5). However, for dioxane solutions, where $(\epsilon_1 - n_1^2)$ is appreciable, ϵp_2 by equations (6) and (7) deviates by more than 5 per cent. from the true value given by (5).

In this connection it is to be pointed out that the recent 'simplified' relationship put forth by Guggenheim³ for computing dipole moments from solution data corresponds to the simplified forms (6) and (7) derived in this note and hence is applicable only for solvents like benzene where $(\epsilon_1 - n_1^2)$ is negligible. Had Guggenheim chosen for his calculations data on dioxane solutions, the failure of his relationship would have been brought out.

Bangalore, B. R. YATHIRAJA IYENGAR.
June 12, 1950.

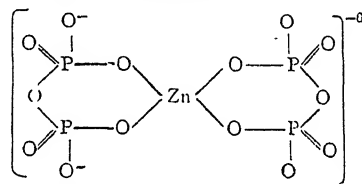
1. Yathiraja Iyengar, *Curr. Sci.*, 1950, 150. 2. Few and Smith, *J. Chem. Soc.*, 1949, 753. 3. Guggenheim, *Trans. Farad. Soc.*, 1949, 714.

INVESTIGATIONS ON PYROPHOSPHATO COMPLEX OF ZINC IN SOLUTION

PAHL³ claimed to have isolated a solid pyrophosphato complex of zinc having the formula $3\text{Na}_4\text{P}_2\text{O}_7 \cdot \text{Zn}_2\text{P}_2\text{O}_7 \cdot 24\text{H}_2\text{O}$, by the spontaneous evaporation of a solution of zinc pyrophosphate

in sodium pyrophosphate at summer heat. Bassett¹ and his co-workers could not confirm his result. The author has, however, observed by different physico-chemical methods, such as used in the case of pyrophosphato complex of lead² and also by Cryoscopy measurements in saturated sodium sulphate solution that the complex ion $[\text{Zn}(\text{P}_2\text{O}_7)_2]^{-6}$ exists in the solution. The instability constant K of the complex ion $[\text{Zn}(\text{P}_2\text{O}_7)_2]^{-6}$ has been found out to be 3.17×10^{-7} at $35.0 \pm 0.1^\circ \text{C}$, where $K[\text{Zn}(\text{P}_2\text{O}_7)_2]^{-6} = [\text{Zn}^{+2}][\text{P}_2\text{O}_7^{4-}]^2$ and the square terms indicate concentrations.

The complex ion $[\text{Zn}(\text{PO}_3)_2]^{-6}$ has probably the following structure with two six membered rings and the co-ordination number of the central zinc ion is four.



My best thanks are due to Prof. P. B. Sarkar, Calcutta University, for his keen interest and for giving laboratory facilities during the progress of the work.

Inorganic Chemistry Laboratory,
University College of Science
and Technology, B. C. HALDAR.
92, Upper Circular Road,
Calcutta-9.

June 14, 1950.

1. Bassett, Bedwell and Hutchinson, *J. Chem. Soc.*, 1936, 1412. 2. Haldar, B. C., *Curr. Sci.* (in previous communication). 3. Pahl, *Ofvers. K. Vet. Akad. Forh.*, 1873, 30, 29.

THE FRIES MIGRATION OF THE ARYL ESTERS OF ALPHA AND BETA NAPHTHOIC ACIDS

CONSIDERABLE work has been carried out on the Fries migration using esters of monohydric phenols with various acids, though much remains to be done especially with those of aryl acids and longchain unsaturated acids with phenols.

In the present investigation this rearrangement has been studied with the phenyl, *ortho*-, *meta*-, and *para*-cresyl esters of α -naphthoic acid at two different temperatures of 100°C . and 160°C . At the high temperatures the *ortho*- and at low temperatures the *para*-hydroxy ketones were obtained, which were characterised by the formation of their 2:4-

Dinitrophenylhydrazones. However, some of the observations are noted below:—

Ester	Hydroxy-ketone	M.P.	M.P. of 2,4-Dinitrohydrazone
1. Phenyl- α -naphthoate	<i>p</i> -Hydroxy-phenyl α -naphthyl ketone	165-66° C.*	287° C.
2. <i>o</i> -Cresyl- α -naphthoate	<i>m</i> -Methyl- <i>p</i> -hydroxy α -naphthyl ketone	165° C.	260° C.
3. <i>m</i> -Cresyl- α -naphthoate	1-Methyl-3-hydroxy 4- α -naphthyl ketone	semi-solid	239-90° C.
4. <i>p</i> -Cresyl- α -naphthoate	1-Methyl-4-hydroxy 3- α -naphthyl ketone	145° C.	221° C.

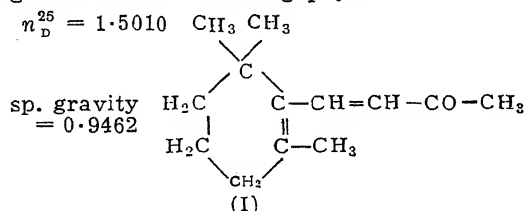
Corresponding work with β -naphthoic acid is being carried out. Fuller details shall be published elsewhere.

Dept. of Chemistry, G. S. SAHARIA.
University of Delhi,
June 19, 1950.

ESSENTIAL OIL FROM THE FLOWERS OF CAMPHIRE OR HENNA PLANT

THE essential oil from the flowers of *Lawsonia inermis* or *Lansonia alba* does not seem to have been studied so far. Deshpande¹ reported that the oil contains a ketone $C_{12}H_{20}O_2$, b.p. 100-02/5 mm.

On steam distillation of the Henna flowers, an essential oil, dark brown in colour, is obtained in 0.02 per cent. yield. It has a very fragrant smell when diluted and congeals on keeping. The fractionation of the oil gave a pale yellow-coloured liquid b.p. 135-40/12 mm. as the main component which darkens on keeping and had the following physical constants.



The oil gives a crystalline semicarbazone $C_{14}H_{23}ON_3$, m.p. 149° C., and a dinitrophenylhydrazone $C_{19}H_{25}O_4N_4$, m.p. 150° C. corresponding to the formula of a monoketone $C_{13}H_{20}O$ for the oil. By comparison of the properties tabulated below, we infer that the chief com-

ponent of the essential oil from Camphire or Henna flowers is β -ionone (I) and further α -ionone is not known to occur in nature. The mixed melting points of the semicarbazones and the dinitrophenylhydrazones obtained respectively from the essential oil from Henna and from a genuine sample of β -ionone showed no depression.

TABLE

Property	Ketone from Henna	β -Ionone	α -Ionone
B.P.	135-40/12 mm.	134-35/14 mm.	123-24/11 mm.
sp. gravity d_{20}^{20}	0.9462	d_{17}^{17} 0.9460	d_{20}^{20} 0.9320
Refractive index — n_D^{20}	1.5033	1.5097	1.4980
Semicarbazone, m.p.	149° C.	148-49° C.	(i) 107-08° C. (ii) 137-38° C.
2, 4-Dinitrophenylhydrazone, m.p.	120° C.	120° C. (not described)	125-28° C.
Oxime	No crystalline oxime obtained	Oxime described to be an oil	m.p. 89-90° C.
Unsaturation	+	+	+

Besides β -ionone, the essential oil also contains a compound containing nitrogen and a resin. Further work is in progress.

Chemistry Laboratory, M. B. ANTIA.
Holkar College, Indore, R. KAUSHAL.
June 29, 1950.

Proc. Soc. Biol. Chemists, India, 1938, 3 (iii), 88.

ELECTRO-DEPOSITION OF METALS AND ALLOYS FROM CYANIDE-FREE BATHS

Part I.—Silver from Iodide Solutions

THE electro-plating industry uses the cyanide bath for the plating of silver (copper, cadmium, gold, etc.), because of its superiority over other types of baths. But the bath suffers from certain serious disadvantages, namely, its poisonous nature and its tendency to decompose, thereby necessitating careful control. It is, therefore, desirable to have a satisfactory substitute for the cyanide bath.

In the present work, silver has been electro-deposited on copper from a silver iodide bath (obtained by dissolving silver salt in alkali iodide) which is much simpler in composition than those attempted before.^{1,2,3,4} As in the cyanide bath, simple immersion deposition is considerably minimised as a result of complex formation, which reduces the effective silver ion

concentration. The latter has been determined by the E.M.F. method. A detailed study has been made of the effect of variation in (a) concentration of silver, (b) concentration of iodide and (c) current density, on the electro-deposition, with baths containing potassium as well as sodium iodides. The deposits are white, dense and readily polishable and the bath is quite comparable to the cyanide bath in respect of quality and adherence of deposit, cathode efficiency and c.d. range. The cathode and anode efficiencies are practically 100 per cent. over a wide range of c.d. and composition. The c.d. range, conductivity and throwing power are found to be higher with the potassium than with the sodium iodide bath. The optimum conditions are: 20 to 40 g/L silver, 400 to 600 g/L potassium or sodium iodide, 0.2 to 1.6 amp/dm² (stirring) c.d., 0.1 to 0.3 volts and 26° C.

The effects of temperature, agitation, ageing, pH and addition agents on plating, have been studied. Increase of temperature and agitation improves the anode corrosion and raises the maximum permissible c.d. Ageing has little effect. Contrary to the observation of other workers,^{3,4} pH as such, is not of much significance but the specific reagent added to vary the pH, is found to have a marked effect on the electro-deposition. Ammonium sulphamate and sodium thiosulphate act as brighteners. The conductivity and cathode polarisation have been measured, the throwing power, as calculated from c.d.—cathode potential curves, is as good as that of the cyanide bath.

The silver iodide bath possesses some important advantages over the cyanide bath in respect of simplicity of composition, ease of control, stability and non-poisonous nature. Furthermore, the high conductivity, low polarisation and low bath voltage lead to lower power consumption. In view of these considerations, this bath appears to be a very promising substitute for the cyanide bath.

Our thanks are due to Prof. B. Sanjiva Rao, Head of the General Chemistry Section, for giving all facilities and taking interest in the work.

Electro-Chemistry Lab., T. L. RAMA CHAR.
Gen. Chem. Section, R. SADAGOPACHARI.
Indian Inst. of Science,
Bangalore-3,
August 9, 1950.

THE INFLUENCE OF DIETARY PROTEIN ON THE CYSTINE AND METHIO- NINE CONTENTS OF LIVER PROTEIN

SEVERAL investigators have studied the variations in the sulfur-containing components of the liver in experimental animals under various dietary conditions.¹⁻⁵ Some of the results are rather divergent. Recently it has been reported⁶ that a considerable alteration occurs in the methionine-cystine ratio of the liver in rats fed for 15 months a low protein rice diet due mainly to a marked reduction in the methionine content.

The authors have determined the cystine and methionine contents of the whole liver proteins from rats fed for different periods a typical poor rice diet as well as synthetic diets of widely varying protein content. The results are presented in this communication.

Comparable groups of young albino rats, 4 weeks old, with an average body weight of 35-40 gm. and containing equal numbers of both the sexes were used for the experiments. The diets were given *ad lib*.

The basal rice diet was composed of: Raw polished rice 79.0 per cent., Tur dhal 5.0 per cent., Non-leafy vegetables (potatoes and brinjals) 8.3 per cent., Leafy vegetables (chiefly amaranthus) 2.2 per cent., Ghee 5.0 per cent., and common salt 0.5 per cent.

The chemical analysis of the dry diet was as follows: Protein (N \times 6.25) 5.89 per cent.; Fat 6 per cent.; Ash 1.8 per cent.; Total sulfur 0.1 per cent.; Phosphorus 0.2 per cent.; Methionine 0.164 per cent.; Cystine 0.095 per cent.

The rice, dhal, vegetables and salt were cooked in 4 volumes of water. The ghee was added later to the cooked diet and thoroughly mixed. As far as possible, the same cooking conditions were maintained throughout the experimental period. The average water content of the cooked diet was 74 per cent.

The synthetic diets contained different proportions of protein as shown in Table I together with the following: Coconut oil 10 per cent., cane sugar 5 per cent., salt mixture 4 per cent., and corn starch to make up the rest.

Each of the animals receiving the vitamin supplemented rice diet as well as the synthetic diets was given daily 1 drop of a solution of Adexolin diluted 10 times with refined groundnut oil and 0.2 g. of Brewers' Yeast (Squibb) with 40 μ g. of thiamine and 70 μ g. of riboflavin added extra.

The livers from the experimental animals were excised under amytal anaesthesia after bleeding through the abdominal aorta. The

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3. Alpern and Toporek, *Trans. Electrochem. Soc.*, 1938, **74**, 321. 4. Levin, *Electroplating*, 1948, **1**, 315.

TABLE I
Cystine and Methionine contents of Liver Protein in Rats

Diet	No. of animals	Period of feeding (Weeks)	Average daily intake*		Liver protein nitrogen (mgm./100 gm. body weight)	Liver protein sulfur (mgm./100 gm. body weight)	Methionine (Per cent. of liver protein containing 16% N)	Cystine
			Food (g.)	Protein (g.)				
Rice diet	8	14	8.1	0.47	105±1.31	10.8 ±0.61	4.2±0.20	1.5±0.28
	10	24	8.5	0.49	106±1.81	11.3 ±0.81	4.3±0.17	1.2±0.33
	8	36	7.8	0.46	104±2.20	10.9 ±0.10	4.1±0.37	1.5±0.17
Rice diet with vitamin supplements	8	14	8.9	0.58	107±2.11	11.1 ±0.72	4.1±0.17	1.3±0.09
	10	24	8.6	0.56	108±1.83	10.8 ±0.86	4.0±0.17	1.1±0.04
	8	36	8.8	0.54	106±1.61	11.0 ±0.15	4.0±0.36	1.6±0.37
Synthetic diets								
20% casein	6	12	8.0	1.68	121±1.99	12.56±0.30	4.3±0.10	1.2±0.00
10% casein	6	12	8.8	0.96	113±1.68	10.01±0.12	3.9±0.37	1.2±0.07
5% casein	6	12	8.8	0.49	105±2.10	9.32±0.19	4.2±0.00	1.2±0.26

* Determined during the last two weeks of the experimental period.

livers thus obtained (as free from blood as possible) were dried to constant weight at 95°C. and then powdered. The dry powder was used for the chemical analyses.

Total protein nitrogen and sulfur were determined on aliquots of the dry powder after extraction with 5 per cent. trichloroacetic acid. Methionine and Cystine were estimated on the dry fat-free residue of the powder after extraction with ether-alcohol (1:3) mixture.

The micro-Kjeldahl procedure was followed for the estimation of nitrogen and the differential oxidation procedure of Evans⁷ for those of total sulphur, cystine and methionine.

The results are given in Table I above.

No significant differences were observed in the cystine and methionine contents of the liver proteins in the various groups, in spite of wide variations in the protein content of the diets and in the period of feeding on the low protein rice diet.

Our grateful thanks are due to Dr. V. Subrahmanyam and Prof. V. R. Naidu for their interest and kind encouragement.

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June 12, 1950.

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280. 5. Dent, C. E., *Ibid.*, 1947, 41, 314. 6. Nutrition Research Laboratories (I.R.F.A.), Coonoor, India, Report for 1948-49. 7. Evans, R. J., *Arch. Biochem.*, 1945, 7, 439.

INFLUENCE OF METHIONINE AND CYSTINE ON THE METABOLISM OF RATS

THE influence of zinc and of choline on the metabolism of nitrogen, phosphorus and sulphur in rats has been reported in earlier communications.^{1,2} It is of interest, therefore, to investigate the influence of methionine, another well-known lipotropic agent and of cystine, the other sulphur amino acid of importance in nutrition. Such an experiment would be of value because cystine has been reported to bring about increased deposition of fat in liver when given alone, while on the other hand enhancing the lipotropic activity of choline when given in combination with it.³

The experiment was conducted in the manner described in the earlier experiments but consisted of five groups of four rats each. The arrangements of the groups and the results of the experiment are summarised in Table I from which it will be seen that the supplements brought about changes in metabolism quite differently from what was observed in the case of zinc, though this element in common with choline possesses lipotropic activity. It is also observed that while choline, acting alone or in combination with cystine, showed marked reduction in the fat content of liver, methionine at the level of 100 mg. per cent. did not lower the same. Cystine when given alone showed markedly increased deposition of fat in liver.

TABLE I

Effect of supplements of choline, methionine and cystine on metabolism of rats fed on a high fat, low protein diet

	Control, High fat low protein diet alone	Supplements			
		100 mg. choline chloride per cent.	100 mg. methionine per cent.	100 mg. cystine per cent.	100 mg. cystine +100 mg. choline chloride per cent.
Increase in body weight (15 days) gm.	19.0	17.0	28.0	15.0	17.0
Food intake in grams (15 days)	123.3	122.2	135.7	107.4	101.2
Metabolism of nitrogen : mg.					
Urinary	.. 634.9	409.4	416.9	252.4	190.9
Faecal	.. 178.6	185.3	189.7	160.9	132.3
Retention	.. 811.7	1031.4	1177.6	1015.3	1053.8
Metabolism of phosphorus : mg.					
Urinary	.. 228.4	157.5	209.4	155.2	133.1
Faecal	.. 122.9	119.9	129.5	109.4	110.2
Retention	.. 137.3	161.7	148.9	120.1	119.2
Metabolism of sulphur : mg.					
Urinary	.. 18.749	17.409	22.672	16.929	18.550
Faecal	.. 34.521	33.659	37.478	31.864	33.996
Retention	.. -5.250	-0.600	21.225	21.030	13.230
Analysis of liver :					
Final body weight gm.	.. 77.5	77.0	93.5	74.0	77.0
Fresh weight of liver gm.	.. 7.29	6.22	9.47	7.31	4.92
Liver weight as % of body weight	.. 9.41	8.07	10.13	9.83	6.39
Fat content of liver gm.	.. 2.115	1.193	2.665	3.039	0.614
Fat percentage in liver	.. 29.05	18.75	28.23	42.20	11.23

In spite of these differences in their influence on liver fat, it was clearly noticed that they all affected metabolism almost identically. They brought about decreased elimination of urinary nitrogen, phosphorus and sulphur while also increasing their retention, thus indicating that their importance in nutrition is connected with some phase of general metabolism other than that indicated by their lipotropic activity.

Further work is in progress and details will be published elsewhere.

My thanks are due to Major-General Sir S. S. Sokhey and Dr. K. Ganapathi for their interest in the work.

Haffkine Institute,
Bombay,
June 26, 1950.

V. SADASIVAN.

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ON A NEW CILIATE *NYCTOTHERUS KALII* NOV. SP. FOUND IN THE TADPOLES OF THE INDIAN FROG, *RANA CURTIPIES* JERDON

THE new species (*Nyctotherus kalii*) described here was found in the intestine of the tadpoles

of the forest-dwelling frog, *Rana curtiplies*. The distinguishing features are, (1) the form and position of the macronucleus and (2) the prominent thin margin or the flange around the body. It has been named after the river Kali, from where the tadpoles were obtained.

Several tadpoles (with hind limbs developed) were opened and the material thus obtained was studied both fresh and in the form of smears. The usual method of fixing and staining (e.g., Bouin's fixative and Delafield's hematoxylin) was followed. All the drawings have been made with the aid of camera lucida.

Nyctotherus Kalii Nov. Sp.

The ciliate when seen from above appears somewhat oval. The two plates of the body namely, the dorsal and the ventral differ both in form and size. The ventral plate is large and tapers anteriorly to a narrow blunt point. Posteriorly it is broader. The dorsal plate, however, being comparatively small, leaves a prominent wide margin over the ventral. This margin or the flange (about 30-40 microns in width) is so thin that the ciliary lines over here are clearly visible. Near the anterior pole the ventral plate is slightly concave for a short distance. The dorsal surface as usual is deeply convex. The short peristome leads into the

cytopharynx which is quite simple in structure and curves round inside the middle of the body. Numerous small and large vacuoles are seen distributed irregularly in the cytoplasm. A large contractile vacuole was always present near the anal opening. The cilia lining the peristome and the cytopharynx are specially long and thick. Those on the body are short and fine. The macronucleus somewhat oval in form is placed immediately over the cytopharynx. Its narrowly pointed anterior pole is almost facing the anterior pole of the body and roughly makes an angle of 41° to the main axis of the body. The micronucleus could not be detected.

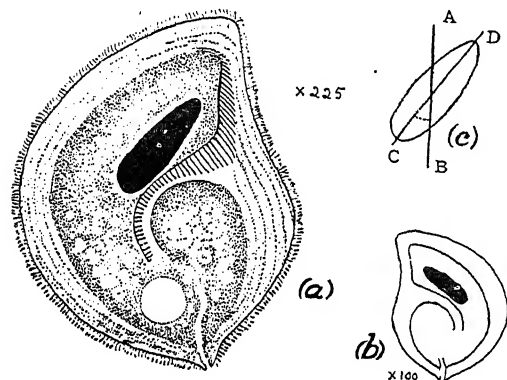


FIG. 1 (a) *Nyctotherus kalii* nov. sp. from the tadpoles of the frog *Rana curtipipes* Jerdon. (b) The same under low power of microscope. (c) Shows the angle made by the macronucleus to the principal axis of the body. The line AB represents the principal axis of the body and CD is the line joining the anterior and posterior poles of the macronucleus.

Measurements in microns:—Body (length \times breadth) range 250-300 \times 200-240; macronucleus (length \times breadth) range 85-110 \times 25-35; nuclear angle 41° ; width of flange 30-40.

There is similarity between the flange described in this new species of *Nyctotherus* and that described by Wichterman in *Nyctotherus cheni* from the Chinese frog, *Rana spinosa*. But there is difference in the form of both the cytopharynx and nucleus. Table I shows how *N. kalii* nov. sp. differs from the one described by Wichterman.

A subpharyngeal tube described in *N. cheni* Wicht., is absent in *N. kalii* nov. sp. Also the macronucleus in *N. cheni* is triangular with a very broad anterior pole, while in *N. kalii* it is oval and has a narrow anterior end. Even

TABLE I

	<i>N. cheni</i> Wicht.	<i>N. kalii</i> nov. sp.
Body size ..	Average 179 \times 121 mcr.	Average 280 \times 223 mcr.
Macronucleus ..	Triangular with interior end broadly rounded. 49 \times 26 mer.	Oval with anterior end narrowly rounded. 101 \times 30 mcr.
Nuclear angle ..	..	41°
Subpharyngeal tube	Pr. sent	Absent.
Width of flange	15 mcr.	30-40 mcr.

in the width of the body-flange and general body contour, the two species differ very much. For these reasons, *N. kalii* has been considered as a new species.

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July 6, 1950.

J. C. UTTANGI.

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EFFECT OF STORAGE ON THE VITAMIN-C CONTENT OF CANNED FOODS

THE following work was undertaken to assess the stability of vitamin-C at room temperature in products processed locally.

A number of tins of the canned product processed in the morning from the same batch of the foodstuff, were brought to the laboratory. One of the tins was assayed for vitamin-C on the same day by the Robinson and Stotz method with formaldehyde procedure.¹ The product was blended in a waring blender for about 2-3 minutes with 0.5 per cent. oxalic acid solution. The intensity of the unreduced dye, extracted in xylene, was noted in a Klett Summerson Photo Electric Colorimeter with a green filter.

The following table gives the data for vitamin-C content during a storage period of 4 months in canned guavas, pine apples and potatoes.

It has been reported that pine apple and pine apple juice retain most of their vitamin-C on storage at 10° and 18.3° . (Moschette *et al* 1947).² Our studies, however, show loss of about 83

per cent. during the four months' storage-period when the average room temperature was 28-30° C.

*Changes in vitamin-C content on storage
in canned foodstuffs at 28-30° C.
mg. per 100 g.*

	* Whole can	Solids	Syrup†	% Solids in the can	% Loss
<i>Pine apple</i>					
Freshly canned	25.81	15.90	15.12	58.5	..
After storage for—					
1 month	21.27	13.08	13.00	58.3	17.7
2 months	13.19	6.96	9.61	58.8	49.0
3 "	7.32	4.11	5.15	59.8	71.7
4 "	4.42	0.80	4.20	51.8	82.9
<i>Guavas</i>					
Freshly canned	265.10	98.77	124.00	41.0	..
After storage for—					
1 month	211.80	138.00	124.00	61.3	20.0
2 months	205.90	116.40	135.00	58.5	22.3
4 "	127.20	65.57	76.25	53.6	52.0
† Brine					
<i>Potatoes</i>					
Freshly canned	..	19.59	13.26	10.00	60.5
After storage for—					
1 month		14.19	9.78	10.00	68.8
2 months		13.82	9.06	8.60	63.7
3 "		8.90	5.76	5.10	61.2
4 "		6.51	4.79	5.25	65.4

* Total content of vitamin C in the can apportioned to solids only.

† mg. per 100 ml.

In the case of guavas, a retention of about 48 per cent. of the original vitamin-C content was noted for over 4 months. Thus it appears that vitamin-C is more stable in canned guavas as compared to canned potatoes and pine apple samples studied.

Biochem. Dept., G. A. DHOPESHWARKAR.
The Inst. of Science, N. G. MAGAR.
Bombay 1,
July 12, 1950.

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THE EARLIEST REFERENCE TO LAC IN CHINESE LITERATURE

IN 1919, Laufer¹ stated: "The *Wu Lu* written by Chang Po in the beginning of the fourth century contains the following text on the subject of ant-lac." His translation is reproduced further below but it is neither complete nor

literal. Strange enough, Laufer does not refer to the previous translation, by Prof. A. Pfizmaier² of Vienna, which appeared in 1874. Although this is complete, it does not reproduce the sense quite happily, so that a third translation seemed desirable. A copy of the Chinese text was sent to me through the kindness of Prof. Tan Yun-Shan of Shantiniketan, which was translated here by Prof. Mu Pai-Hui, formerly also of Shantiniketan. It is a pleasure to express my thanks again to both these Chinese scholars. I have been responsible for the form in which the translation is being presented, by having given preference to some synonyms over others; but I have added notes to explain my choice.

Laufer translates as follows: "In the district of Kü-Fun in Kiu-Chen, Tonking, there are ants living on coarse creepers. The people, on examining the interior of the earth, can tell the presence of ants from the soil freshly broken up; and they drive tree-branches into these spots, on which the ants crawl up and produce a lac that hardens into a solid mass." This is Laufer's entire translation, which may be critically compared with the following, by Prof. Mu Pai-Hui: "(1) In the northern portion of Chiu-Chen (now Indo-China) there is the district named, I-Fung, where a gum (Chiao) is used for dyeing raw-silk (Hsü) red. (2) By observing the soil the people can tell where the ants are. (3) And because of ants) they dig holes there and plant branches of trees into them. (4) The ants crawl upon the branches and produce the lac (Ch'i). (5) It hardens into a mass resembling a cocoon (or rather) the egg-case of a mantis. (6) It has a pure (bright) red colour. (7) It is this gum which dyes raw-silk red."

In sentence No. 1, the word *chiao* is translated as *gum*. The original word has also been used in a generic sense; *chiao* also means glue, being the sense preferred by Pfizmaier, who renders it, in German, as *leim*. The same sentence contains the term "raw-silk", for the Chinese word, *Hsü*. It is character No. 4474 in the *Chinese Dictionary* of Giles, with the meaning, "refuse silk or cotton". Since cotton does not take to lac-dye, only some kind of silk can be meant here. Pfizmaier renders the same word as "flockseide" or "floss-silk", which is another synonym for refuse silk. I, however, feel that the more general term, raw-silk, best expresses the sense of the original text. In sentence No. 4, *Ch'i* is a well-known word translated as *lac*. It usually means lacquer in Chinese, but here *lac* is the best substitute for

it. Pfizmaier gives it as *pech* or *pitch*, which hardly suits the context. In sentence No. 5, the Chinese text contains a phrase which has been very well expressed. Incorporated in that phrase is the word *p'iao*, character No. 9130 in Giles. This author gives another synonymous phrase again with *p'iao*, which he translates as "an egg-cocoon, like that of the mantis". This is exactly what Chang Po also meant. Gum-lac, as a specific term, is rendered in Chinese as *ant-lac*, which Laufer correctly expresses.

Gum-lac is sometimes seen in small round chunks, illustrated as early as 1760, by Leder-müller.³ Slightly larger pieces have been shown in 1789, by Roxburgh and in 1947, by myself⁴ when I have also reproduced Roxburgh's pictures. Small in size and, attached to fine twigs such lac encrustations do resemble egg-cases of mantis; hence a comparison between them both seems most appropriate. The contents of sentence No. 4 strikes us as naive. It can nevertheless be confirmed, as by the following quotation from the *Cyclopaedia* of Chambers⁵ published in 1786, where we read that, "Father Tachard, who was on the spot (in India), tells us that a kind of little ants, fixing themselves on the branches of trees, leave behind them a reddish moisture which, lying exposed to the air and sun, hardens in five-six days' time and becomes lacca". Such reports can be confirmed by questioning country folk even to-day.

Cipla Laboratories, S. MAHDIHASSAN.
Bombay 8,
August 5, 1950.

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Phosphate-fixing capacity of alluvial soils at different depths in both manured and unmanured plots

TABLE I

	Manured annually with dung supplying 100 lb. N. per acre				Unmanured			
	0-6" mgm. %	6"-1' mgm. %	1'-2' mgm. %	Mean mgm. %	0-6" mgm. %	6"-1' mgm. %	1'-2' mgm. %	Mean mgm. %
Soil	0.0642	0.1120	0.2265	0.1342	0.0921	0.1495	0.2082	0.1499
H ₂ O ₂ treated soil	0.0721	0.1181	0.2302	0.1401	0.0984	0.1539	0.2105	0.1542
Depression in P ₂ O ₅ fixing capacity due to organic matter	-0.0079	-0.0361	-0.0037	-0.0059	-0.0063	-0.0344	-0.0023	-0.0043
Sand fraction	0.0016	0.0012	0.0003	0.0010	0.0025	0.0016	0.0006	0.0016
Silt fraction	0.0620	0.1850	0.2160	0.1540	0.0930	0.2067	0.2270	0.1750
Clay fraction	0.4640	0.3710	0.6490	0.4610	0.5870	0.5560	0.6180	0.5870

PHOSPHATE FIXATION IN ALLUVIAL SOILS

THREE views have recently but quite independently developed on P₂O₅ fixation in soils. Perkins and Coworkers,¹ and Richards and Collaborators² hold that particle size influences phosphate fixation. Larger the particle size, the lesser is the fixation as the total surface for activity is proportionately reduced. According to Laatsch³ positive secondary valencies of the clay mineral lattice are saturated with humus leaving very little scope for P₂O₅ fixation. On the other hand, Dunn⁴ believes that humus which acts only as a cementing material when suitably removed, increases phosphate fixation.

During the course of an investigation on the effect of continuous cropping on the nutrient status of the alluvial soils of Kanpur, it occurred to us to test the above three views on phosphate fixation, as shown by the soils of our permanent manurial plots running over nearly 63 years. The soils as reported by the authors⁵ are micaceous. The more important results are incorporated in Table I.

The data presented in the table show that clay in general fixed the most P₂O₅, followed by silt and sand. These fractions of the unmanured plot have fixed more than the manured; this is evident in the first foot of the soil which is cultivable.

Removal of the humus by H₂O₂ increased P₂O₅-fixing capacity. The original soil fixed 0.1420 mgm. P₂O₅ as compared to 0.1471 mg. P₂O₅ for the H₂O₂ treated soil. When the mean increase after peroxide treatment is compared, it will be observed that the mean for the manured increased by 0.0059 mgm. per cent., as compared to 0.0043 mgm. per cent., for the unmanured soil. This increase is definitely due to

removal of humus for both manured and unmanured soils.

This lower P_2O_5 fixing capacity of the manured soil may be attributed to the dual role of humus; the excess of added humus in excess of that naturally present, besides partly saturating the partial secondary valencies acts also as a cementing agent. Such cementing effect is possibly not marked because of the small amounts of humus in the unmanured soil. The difference of 0.0016 mg. or 37 per cent. mg. P_2O_5 of the total P_2O_5 fixing capacity of the manured soil therefore, may be ascribed to the decementing after peroxide treatment, and .0043 mg. fixation in both the soils due to the saturation of the partially-saturated secondary valencies of the mineral lattice. This effect of organic matter is thus due to both the partial saturation of the secondary valencies of the mineral lattice by the organic colloids and the external coating of humus on the soil particles.

The above results thus clearly demonstrate that all the three factors which are reported to effect P_2O_5 fixation operate almost simultaneously in our soils. Whether they operate in other types of soils is being examined on laterites and regurs.

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Govt. Agric. College, S. K. MUKERJI.
Kanpur, J. G. SHRIKHANDE.
July 26, 1950.

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297. 5. *Curr. Sci.*, 1949, 18, 373.

THREE STYLED ORYZA

GRAMINEÆ is characterised by two styles with plumose stigmas except in a few primitive Bambuseæ which have three styles. *Oryza* also has generally the two styles; sometimes a third additional "nonstigmatic process" may be present (Arber, 1934). Hector (1936) while describing the gynæcium of *Oryza sativa* states that a third style may be present. In a vast collection of about 2,200 types of *Oryza* obtained from different parts of the world and maintained at the Paddy Breeding Station at Coimbatore, a West African species *Oryza grandiglumis* Prodoehl, showed the three styled condition in many of the spikelets. Normal two styles were also found in the same plant. The third style with the stigmatic branch was normal in all respects (Fig. 1).

The serial transverse sections of the ovaries from the three styled and the normal two

styled spikelets were examined to compare the vascular strands. The normal *Oryza sativa*



FIG. 1

showed two vascular strands on the ovary wall (Fig. 2). This is in conformity with the observations of Saunders (1928) and Arber (*loc. cit.*).

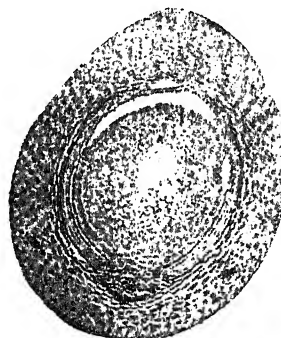


FIG. 2

But the three styled *Oryza grandiglumis* has three vascular strands (Fig. 3) and this justi-



FIG. 3

fies the normal third style in the species. In the case of the two styled ovaries of *O. grandiglumis*

glumis, the vascular condition agrees with the normal *Oryza sativa*. The isolation of the three styled condition is being carried out. Saunders (1937) reports a more or less similar case in *Spartina stricta* where two or three vascular strands in the ovary wall end in correspondingly two or three stigmatic branches. On the other hand, the same worker reports *Stipa pinnata* which has the three vascular strands but is lacking in the third stigmatic branch.

Though the ovary of Gramineæ is generally considered to be of three carpels, there is no unanimity of this view; some consider it to be of a single carpel (Bews, 1929). If the vascular strands are taken to represent the midribs of the carpels as viewed by Arber, the present case with the three styles and the three vascular strands adds support to the tricarpeal view. Further work on this aspect is in progress.

We are thankful to Sri. M. B. V. Narasinga Rao, Paddy Specialist, for providing the material.

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D. DANIEL SUNDARARAJ.

K. RAMANATHAN.

Agri. Coll. & Res. Inst.,
Lawley Road P.O.,
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May 17, 1950.

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CERCOSPORA LEAF-SPOT ON *SCHREBERA SWIETENIODES* ROXB.

A *CERCOSPORA* leaf-spot on *Schrebera swietenoides* Roxb. was first observed at Nagpur in 1948. The disease is indicated by the appearance of minute yellowish specks on the upper side of the leaves which soon turn chocolate in colour and become visible on the underside as well. The young spots are at first roundish, but later become irregularly angular. As they mature, the centre turns dirty brown to greyish-white and becomes slightly depressed. Later on clusters of conidiophores appear in the whitish areas on either side of the leaves as

minute black dots. Several adjacent spots often coalesce together, forming large patches of dead areas on the leaf-blades. Later in the season the spots occur on petioles and twigs. The spotted leaves gradually turn pale, dry and fall off.

The hyphæ of the pathogen are chiefly intercellular, sub-hyaline to brown, septate and frequently branched. The sporodochia are large, stromatic and typical in shape. They are formed either under the epidermis, within the epidermal cells, beneath the cuticle or in the substomatal spaces. The conidiophores emerge through the epidermis or stomatal openings. They may also arise singly from the external mycelium. They are brown, continuous or 1 to 5-septate, usually undulate, frequently nodulose, simple or sparingly branched, occasionally once or twice geniculate and measure $9.5-4.2$ (average 25.44) \times $2.4-6.2$ μ (average 3.12).

The conidia are sub-hyaline to pale olive brown in colour, cylindrical to obclavate in shape, sometimes typically branched, usually curved and occasionally constricted at septa. As they grow old, one or more oil-globules appear in each cell. They are 1 to 10-septate, usually 3 or 4-septate and measure $18.3-87.0$ (average 46.47) \times $2.8-6.1$ μ (average 3.60). They germinate in water in 12 to 18 hours. The germ-tubes usually arise from the terminal cells, but occasionally from one or two intermediate cells. Anastomosis between germ-tubes or germinating conidia occurs occasionally.

Spraying the foliage with a conidial suspension resulted in the characteristic symptoms of the disease in 7 to 10 days. Examination of the infected leaves showed that the organism enters through the stomata.

The pathogen was isolated in pure cultures. The organism when grown on rice-meal agar at 22° C. began to grow actively on the 4th day, forming densely matted dark greenish-grey, circular colonies with a greyish-white fluffy aerial growth in the centre. The colonies measured 8-12 mm. in 12-15 days. The hyphæ measure $0.9-4.7$ μ (average 3.42). The submerged hyphæ are darker in colour and more frequently branched than the aerial ones. Conidia are not formed in cultures.

Since the organism does not seem to have been described before, and since its habitat, characters of stromata, conidiophores and conidia on the host and cultural characters are typical, it is considered to be a new species and named *Cercospora schreberæ* n. sp.

My thanks are due to Dr. R. P. Asthana, Mycologist to Government, Madhya Pradesh, for the facilities accorded to study the problem.

Agric. Res. Institute, K. A. MAHMUD.
Nagpur,
June 10, 1950.

AN 'IN VITRO' STUDY ON THE ACTION OF ACRIDINE BIGUANIDE DERIVATIVES UPON SOME PATHOGENIC MICRO-ORGANISMS

THE bacteriostatic activity of the acridine drugs was first observed by Browning, *et al.*¹ and this was later followed by the discovery of 'atebrin' as the most important acridine antimalarial compound.²

The general effectiveness of the acridine compounds against a wide variety of bacteria is well established.^{3a, 3b} These acridine antibacterials, aminoacrine, proflavine, acriflavine, salacrine, etc., are superior in one respect, to penicillin and sulphonamides, as they do not produce resistant strains of organisms.^{4, 5} But their general usefulness is much limited as the drugs are excreted quickly and do not persist in blood stream for sufficiently long time. Nevertheless, the long persistence of atebrin in blood encourages the hope of finding some suitable acridine antibacterials. Biguanide sulphanimide derivatives and paludrine acetate have

been found to have bacteriostatic effect against some gram-positive organisms.⁶

The present investigation was undertaken with the object of determining the effectiveness of some acridine biguanides as antibacterial agents. These compounds were originally synthesised as possible antimalarials.⁷ It is well known that quite a number of 'enteric infections' are complicated with malaria and any antimalarial drug having, in addition, some antibacterial properties against enteric group of organism, will certainly prove very fruitful during the epidemic of enteric infection.

With this object in view, these compounds were tested against *Bact. coli* and *Bact. typhosum* besides the usual pathogenic gram-positive organisms. The antibacterial spectrum of these compounds is given below (Table I).

A perusal of the table shows that paludrine has slight antibacterial activity against all the organisms while 5-amino acridine is bacteriostatic in fairly high dilutions against both gram-positive and gram-negative organisms. The combination of the two groups (acridyl biguanides) in general seems to have enhanced the activity against the gram-positive organisms and some of the compounds 3, 4 and 5 are found to be powerful bacteriostatic agents against *Bact. typhosum* and *Bact. coli*.

Our thanks are due to Prof. P. C. Guha for kindly offering the compounds and to Dr.

TABLE I

Compound	Minimum bacteriostatic concentration (48 hrs. incubation at 37° and pH 7.2)			
	Organism			
	Staphylo	Strepto-hemolyticus	<i>B. coli</i>	<i>B. typhosum</i>
1 5-Amino acridine ..	1 : 25,000	1 : 10,000	1 : 10,000	1 : 10,000
2 N'-(α -naphthyl)-N ⁵ -(5-acridyl) biguanide hydrochloride ..	1 : 20,000	1 : 20,000	1 : 2,500	1 : 2,500
3 N'-(5-acridyl)-N ⁵ -(p. cl. phenyl) biguanide hydrochloride ..	>1 : 50,000	>1 : 50,000	1 : 10,000	1 : 10,000
4 N'-(2 : 4 dichlorophenyl)-N ⁵ -(5-acridyl) biguanide hydrochloride ..	1 : 30,000	1 : 30,000	1 : 12,500	1 : 12,500
5 N'-(5-acridyl)-N ⁵ -(p. bromophenyl) biguanide hydrochloride ..	1 : 50,000	1 : 50,000	1 : 12,500	1 : 12,500
6 N'-(2-chloro 7 methoxy acridyl)-N ⁵ -(p-chlorophenyl) biguanide hydrochloride ..	1 : 25,000	<1 : 10,000	<1 : 10,000	<1 : 10,000
7 N'-(p-bromophenyl)-N ⁵ -(2 chloro-7-Methoxy acridyl) biguanide hydrochloride ..	1 : 50,000	1 : 50,000	1 : 5,000	1 : 2,500
8 N'-(p-Iodophenyl)-N ⁵ -(5 acridyl) biguanide hydrochloride ..	1 : 50,000	1 : 5,000	1 : 10,000	1 : 10,000
9 Paludrine hydrochloride ..	1 : 10,000	1 : 5,000	1 : 5,000	1 : 1,000

N. N. De and Dr. K. P. Menon for the keen interest evinced in the work.

Pharmacology Laboratory, M. SIRSI.
Ind. Inst. of Science, P. R. GUPTA.
Bangalore 3, R. RAMA RAO.
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DEVELOPMENT OF EMBRYO SAC AND ENDOSPERM IN *STYLIDIUM* *TENELLUM* SWARTZ.

In *Stylidium tenellum* Swartz., a member of the Stylidiaceae, the hypodermal archesporium is differentiated in the young nucellar primordium and it functions directly as the megaspore mother cell (Fig. 1). Tetrad formation takes place normally, the chalazal megaspore functions and the development of the embryo sac (Figs. 3, 4), follows the Polygonum type.¹ Occasionally, a T-shaped tetrad is met with or the division in the upper dyad cell is oblique (Fig. 2).^{2,5,6}

The mature embryo sac is long (Fig. 4) and is surrounded by an endothelium whose cells at the lower end become filled up with dense contents. The synergids are long and hooked and the egg is pear-shaped. The secondary nucleus is large and the antipodal cells persist (Figs. 6-8) during the early stages of endosperm development.^{2,3,5,6} Double fertilisation takes place normally (Fig. 5) and immediately after fertilisation the synergids shrivel and degenerate.

Endosperm development is cellular. The primary endosperm nucleus divides much earlier than the fertilised egg. Its division is followed by the laying down of a transverse wall (Fig. 6) resulting in a primary micropylar and primary chalazal chamber. Next, vertical walls are laid down in both the primary chambers, thus resulting in a 4-celled endosperm. Transverse walls are now laid down first in the lower tier of cells (Fig. 7) and then in the upper tier; thus an 8-celled endosperm is formed (Fig. 8). *Stylidium graminifolium*⁵ and *Levenhookia dubia*⁶ are slightly different in that transverse walls are first laid down in the upper tier and then in the lower. At the 8-celled stage of the endosperm, the two cells of the upper tier develop into the micropylar haustorium and those of the lower form the chalazal haustorium. The two middle tiers of

cells by further divisions form the main body of the endosperm. The development of the endosperm thus follows the *Scutellaria* type⁴ and

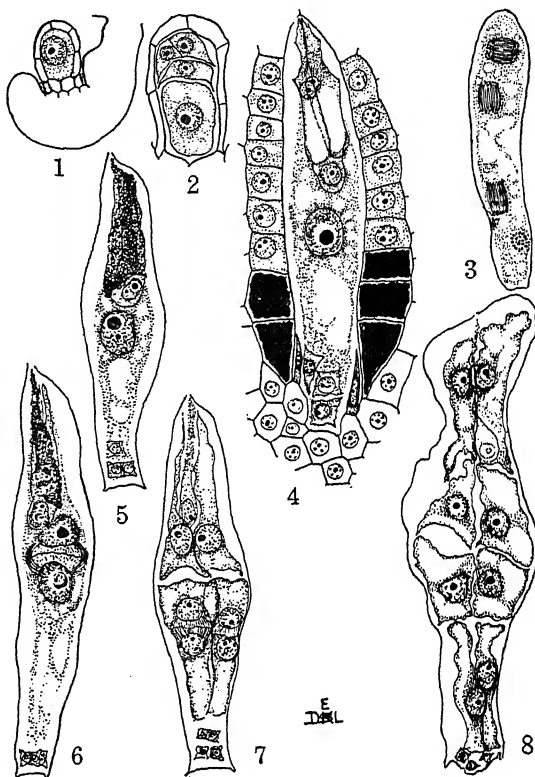


FIG. 1. Megaspore mother cell $\times 485$. Fig. 2. Megaspore tetrad with oblique wall in the upper dyad cell $\times 970$. Fig. 3. Third nuclear division from megaspore leading to formation of 8-nucleate stage $\times 970$. Fig. 4. Mature embryo sac showing the elongated synergids and endothelium $\times 970$. Fig. 5. A stage in double fertilisation $\times 679$. Figs. 6-8. Stages in the development of the endosperm and the differentiation of the micropylar and chalazal haustoria. Figs. 6, 7 $\times 679$, each; Fig. 8 $\times 485$. a similar sequence of divisions has been reported in *Stylidium adnatum*,² *St. graminifolium*,⁵ and *Levenhookia dubia*.⁶

It gives me great pleasure to thank Prof. P. Maheshwari for sending me the preparations, on which the present observations are made; I also thank Prof. L. N. Rao for kind encouragement and the National Institute of Sciences of India for the award of a Research Fellowship.

Dept. of Botany, K. SUBRAMANYAM.
Central College, Bangalore 1,
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REVIEWS

Vacuum Equipment and Techniques. By A. Guthrie and R. K. Wakerling. (McGraw Hill Book Co., Inc., New York), 1949. Pp. 264. Price \$ 2.50.

The much-discussed and much-condemned atomic weapon of war, conferred at least one benefit on experimental science and that is the development of high vacuum systems of colossal dimensions, far exceeding the size of the largest molecular stills. The routine production of high vacuum required on an unprecedented scale in the electromagnetic separation process was entrusted to a group, nay a team, of eminent scientists and engineers of the University of California Radiation Laboratory, under a contract with the Manhattan Project. The magnitude and nature of the problems involved compelled a good deal of pioneering work on both equipment and testing techniques.

The excellent monograph under review, is based on a record of the observations made by the personnel of the U.C.R.L. in the course of this development and as such is a fitting memorial to the accomplishments of science, Industry, Government, Labour, Army and Navy working harmoniously as a team. E. O. Lawrence, the Director of Radiation Laboratory, gives away the secret of this remarkable achievement in his Foreword to the book, where he says: "*The entire laboratory organization was characterised by a minimum of formal procedure consistent with the nature of the work The form of laboratory organization was such as to allow a maximum of individual expression with regard to the various problems encountered, which undoubtedly contributed considerably to a maximum of co-operation.*" (italics ours)

The first chapter of the book deals with the fundamental theoretical considerations of vacuum practice, where it is assumed that the reader is already versed in the kinetic theory of gases. Special equations of vacuum practice are developed and discussed in extenso.

The subsequent chapters are concerned more with the practical aspects of the various elements of a high vacuum system, including the design and operation of mechanical, jet and diffusion pumps, various types of cold traps, high vacuum valves and finally the construction of vacuum chambers and process tanks which could be relied on to hold the vacuum. Various devices for producing motion in vacuum chambers, new instruments for vacuum

measurements, detection of leaks with the mass-spectrometer and a host of other topics related to the industrial application of high vacuum are all very well discussed. There is an extended appendix which includes a summary of formulæ useful in vacuum design, certain constants, conversion factors, data on pump oils, vacuum greases, effectiveness of various drying agents, etc.

References are made liberally to the available published literature. M. V. C. SASTRI.

Fire in Buildings. By Eric L. Bird and Stanley J. Docking. (Messrs. Macmillan & Co., London), 1949. Pp. 295. Price 15 sh. net.

This book is an excellent survey of the work carried out during recent years in the field of fire protection and fire-resistance of structures. It covers nearly 300 pages divided into 15 chapters and is illustrated with numerous diagrams, charts, drawings, and photographs.

Tracing the history of the early fire-combating and fire-preventive measures, and recalling the poignant tales and disastrous results of some of the world's worst fires, the authors analyse the complex factors influencing the behaviour of fire in buildings and explain the basic aims of fire protection in the first five chapters, and proceed to discuss the principles and practice of fire-protection methods as have emerged from the fire-research laboratories in England and America, and the practical results achieved so far.

The concept of "fire load" which expresses the total calorific value of the combustible contents of a structure and its occupancy per unit area—and thus a measure of the relative potential severity of a fire in a structure—is utilised to evolve a rational system for assessing fire-risks and classifying buildings according to their fire-resisting properties. The modern method of "fire grading" and the recommendations of the Fire Grading Committee based on this fundamental concept are discussed in the text in great detail.

Of particular interest are the results of tests on the behaviour of materials and structures under varying conditions of fire, and the time-temperature graphs showing the relationship between the rise in temperature and duration of fire.

The remaining chapters are devoted to the planning and design of structures for fire-resistance. The numerous illustrations of the

application of the theory of compartmenting to varied types of structures and the different fire-preventive devices described in these chapters should be of special interest to all practising architects and planning engineers.

N. S. GURCHUP.

Practical Physics. By Sir Cyril Ashford. (Cambridge University Press), 1950. Pp. 173 + xii. Price 10 sh. 6d.

It is now a matter of common recognition that on account of the large increase in the number of students proceeding to study physics at the intermediate and Pass stages and inadequate equipment of our laboratories, teachers are unable to give their best in the matter of practical work. Individual attention is no longer possible. These causes have led to much deterioration in the quality of physics teaching. Much of the work in the laboratory is done in a routine manner, without any regard to accuracy of observation, correlation with theory and proper utilization of available data.

This sorry state of affairs needs immediate revision at the hands of those interested in the advancement of science in this country. One of the books which is sure to help the zealous reformer is the one under review. Sir Cyril Ashford has brought to bear on this work his considerable experience as teacher and examiner.

In the Introduction, several practical points in the reduction of observations are clearly and briefly stated. Due emphasis has been laid on graphical methods, which are illustrated with suitable examples.

The fifty exercises described in the book are generally based on questions set in recent years in the Higher School Certificate papers. The orthodox teacher may rightly claim that the experiments are not those usually prescribed in our colleges. But as review experiments and for frequent practical tests, the exercises are well adapted. Each exercise is accompanied by a note on the underlying theory.

To those teachers in South India who are continually for reducing standards, one may mention that the experiments outlined in the book are essentially intended for pre-university examinations. The experiments require apparatus usually existing in any laboratory. The reviewer agrees wholeheartedly with the author in the view that a student should learn to rely on his own powers rather than on elaborate equipment.

Students and teachers of physics will find much in the book which will be instructive and useful.

S. R. R.

Intermediate Organic Chemistry. By P. B. Sarkar. (H. Chatterjee & Co., Ltd., Calcutta), 1950. Pp. 178. Price Rs. 2-8-0.

The book is an abridged edition of the relevant chapters of *Organic Chemistry*, by Sarkar and Rakshit, intended for B.Sc. students of the Indian Universities. The book mostly deals with the Chemistry of the aliphatic compounds. The preparation, properties, uses and technical applications, if any, of important members of each group of compounds are clearly and concisely described in the first seventeen chapters of the book. Amongst aromatic compounds the Chemistry of benzene, its homologues, naphthalene, and the more important derivatives of benzene are discussed in the last four chapters.

The arrangement of the subject matter is quite good, the presentation is excellent and very readable. There is ample information for the Intermediate students; and others who read the book will find a useful introduction for the further study of Organic Chemistry. On the whole, this is an excellent book for the Intermediate students and there is no doubt that the book will be as popular as the bigger volume on the same subject by the author.

M. SHADAKSHARA SWAMY.

Jan Ingenhousz: Plant Physiologist, with a History of the Discovery of Photosynthesis. By Howard S. Reed, Ph.D. (*Chronica Botanica*, 11, No. 5/6). (The Chronica Botanica Co., Waltham, Mass., U.S.A.; Macmillan & Co., Ltd., Calcutta, India), 1949. Pp. 393. Price \$ 3-00.

This book is a fully annotated and well-illustrated reprint of Ingenhousz's classical work on plant physiology. This distinguished eighteenth-century physician first attained fame by immunizing patients against small-pox by vaccination. His versatile mind later set itself to the study of Physics and certain aspects of plant physiology. Experimenting in the latter field of science, he achieved some important results. He showed that plants exhaled "dephlogisticated air" (oxygen) during photosynthesis, that this activity was unconnected with growth, and that it was very vigorous in bright sunlight, that it decreased as light declined and that it ceased altogether in darkness. Ingenhousz (1730-99) was the first to observe respiration in plants although he was not aware of its significance. Repeating Priestley's experiments he found that green parts of plants "vitiating" the air around them in darkness, while non-green parts like flowers, fruits and seeds also behaved similarly both in darkness and light. Ingenhousz was not even aware of

the nature of this vitiating gas. It was only in 1804 that De Sature carried out the first experiments in respiration and it became evident that carbon assimilation and respiration were two different activities of the green plant, but going on simultaneously during the day. The effect of atmospheric electricity on plants also engaged his attention but yielded no important result. His study of soil chemistry led him to think that the soil also drew oxygen from the air and gave out carbon dioxide. He little realised that this oxidation was due to micro-organisms.

Essentially of historical interest, the book deals mainly with Ingenhousz's experiments, his technique, the apparatus he used, his explanation of technical terms, his inferences and his dedication of his work to Sir John Pringle, from whom he received inspiration and encouragement. A special chapter outlines the "chemical studies that led to the discovery of photosynthesis" and reviews the works of scientists like Hales, Cavendish, Priestley, Senebier and others, who were all interested in photosynthesis. The commentator who is none other than Prof. H. S. Reed, well known for his *History of the Plant Sciences*, has made the book very interesting and instructive. He has not only shown the value of Ingenhousz's work judged by the contemporary knowledge of plant physiology, but has also shown its directive influence on subsequent research in this branch of knowledge. Each experiment or set of experiments on a particular subject is described in Ingenhousz's own words. The commentator then adds very useful notes annotating the experiments and tracing further developments in the subject till modern times. A valuable list of references at the end of each chapter, a short biographical sketch, a couple of letters from Franklin to Ingenhousz and several hitherto unpublished illustrations of topical interest, all contribute to the importance of the book. Clear types, faultless printing and a neat get-up greatly add to its charm.

A. R. RAO.

Botanical Nomenclature and Taxonomy (*Chronica Botanica*, 1950, 12, No. 1/2). Edited by Prof. J. Lanjouw, Ph.D. (Publishers: Walham, Mass.: The Chronica Botanica Co., Calcutta: Macmillan & Co., Ltd.) Price \$2.50.

The appearance of this work is most timely in connection with the sessions on nomenclature at the 7th International Botanical Congress now being held in Stockholm. For this, plant

taxonomists and systematists owe a debt of gratitude to the editor of this work, Prof. J. Lanjouw. The book gives a report of a symposium organised by the International Union of Biological Sciences, with the support of the UNESCO at Utrecht in June 1948. As Prof. Lanjouw states in his preface to the Report, this symposium was a means of bringing together a few of the leading botanists and taxonomists for a preliminary meeting "to pick up the threads of international contacts, which had been cut so roughly in 1939," and to consolidate view-points to be placed before the 7th International Botanical Congress. This Report embodies detailed minutes of the discussions at the symposium, so carefully recorded by Mrs. M. L. Sprague, and includes also valuable supplements. One of these deals with the amendments to the International Rules of Botanical Nomenclature made at the 6th International Congress, and in another, "On the Need for an International Society of Plant Taxonomists", Prof. Lanjouw makes a strong plea for the organisation of such a body. It is also noteworthy that the report contains some references to the early history of Botanical Nomenclature incorporated in the body of the proceedings of the symposium.

Altogether, the Report should be a welcome and valuable addition in all the botanical laboratories, and should be especially useful to botanical workers in the field of systematics and nomenclature. It is, however, felt that the price of the book is a little too high.

ESBEEKAY.

Introduction to the Bacteria. By C. E. Clifton. First Edition. (McGraw Hill Book Co., Inc., New York), 1950. Pp. xii + 528. 179 diagrams and photographs. Price \$5.00.

The publication of text-books on general bacteriology is by no means uncommon and the majority of such books show a pronounced bias towards medical bacteriology. It is seldom realised that by far the largest number of micro-organisms occurring in nature are nonpathogenic to plants, animals or humans and many of them are intimately associated with the every-day life of man. Yet, information regarding this very large group of organisms, which is of fundamental importance, is not commonly presented.

The book under review is a welcome departure from the usual methods of presentation of the subject and is intended, as the author so aptly puts it in his dedication, for "those students who develop an interest in the bacteria,

as bacteria." The book is divided into 24 chapters, the first 7 dealing with the introduction and general observations on bacteria, protozoa and algæ, true fungi and viruses. Then follow some very interesting chapters on the energy requirements of bacteria, microbial respirations, metabolic grouping of bacteria and growth requirements, multiplication and death of bacteria. After discussing the utility of Bergey's classification, the author deals, in the course of next 7 chapters, with some aspects of applied bacteriology such as those pertaining to soil, water, air, food and industries. The mechanisms of infection and resistance, serological reactions, and characteristics of the family Enterobacteriaceæ have been described in the next 3 chapters followed by a concluding chapter on microbiology of infectious disease.

The material is presented in a clear and critical manner taking into consideration the latest developments in the various branches of bacteriology. The book is written in a very readable style, is profusely illustrated with beautiful photographs and charts, and contains numerous references and an index. The get-up of the book is excellent and this reviewer commends it highly to everyone interested in bacteriology.

K. K. IYA.

Administration Reports of the Director of National Museums, Colombo, for 1948 and 1949. (Ceylon Government Press, Colombo). Price 55 cents each.

These business-like reports give the impression that the Government of Ceylon do not treat their museums as the Cinderella of Government departments. The Island has a large national museum at Colombo and three regional museums at Jaffna, Kandy and Ratnapura, and all of them had, during the two years under report, vigorous programmes of research and collection. The total number of visitors to the Colombo Museum, in 1949, was 188,183 and of these about 20 per cent. were school children, indeed a very pleasing and healthy record. There is also to be found a proper balance between research, gallery work, publication, and educational activities. On the research side specially noteworthy is the paleontological and prehistoric work of the Director in Ceylon and in Africa as a member of the University of California African Expedition. Research in Anthropology which was interrupted during the war has been resumed and is making very good progress. Another very

pleasing feature, little known in India, is the number of gifts which the National Museum has been getting from the members of the public. The *Spolia Zeylanica*, the periodical publication of the Museums Department, has also maintained its very high standards. Mr. P. E. P. Deraniyagala, the versatile Director of the National Museums, deserves to be congratulated on the excellence of the record of work for these two years.

A. A.

Modern Text-book of Intermediate Physics—Vol. II. By Amarendra Nath Banerjee, M.Sc. (Published by Das Gupta & Co., Ltd., 54/3, College Street, Calcutta).

The book has been written primarily with the intention of providing a suitable modern treatment (as the title indicates) of the subject matter of Physics for the Intermediate classes. With this object in view, the author has included topics such as dispersion in optics and alternating currents in electricity (which he has referred to in the preface) which are not ordinarily taught in the Intermediate classes. The Intermediate stage should certainly be made more substantial and from this point of view, the attempt is very welcome.

While the author's desire that the students should be enabled to draw from the 'pages of nature' is commendable, it is possible to disagree with the method adopted in the book to secure that end. For example, the mention of the dualistic nature of light in the opening pages tends to obscure the young mind rather than help him to proceed step by step. Facts must be carefully and judiciously presented and theories must be made to appear as natural developments arising from the presented wealth of facts. Moreover in an effort towards developing a scientific tendency, accuracy of statement is very important. The errors of commission such as on Page 49, where radius of curvature (which is a distance) has been referred to as a straight line and omission such as on Page 74, where no mention is made of the fact that $\sin i / \sin r$ depends on colour ought certainly to be avoided. Several mistakes in the spelling of words as also misprints are to be corrected. However, considerable amount of new material has been added and the illustrations given are helpful. The desire of the author to create a love for the subject among the beginners could perhaps be better realized by suitable acknowledgements, references and suggestions for further study.

D. S. SUBBARAMAIAH

SCIENCE NOTES AND NEWS

Estimation of Argemone Oil in a mixture of Argemone and Mustard Oils

Shri. K. P. Bhargava, Manager and Chief Chemist, Juggilal Kamlapat Oil Mills, Cooper-ganj, Kanpur, writes as follows:—

Dr. S. N. Sircar in an article published in *Current Science*, August 1945, Pp. 196-197, describes a chemical method for the estimation of alkaloids present in argemone oil and its application to a mixture of argemone and mustard oils. In the last paragraph of the article it is stated that the method with practically the same degree of accuracy is applicable to a mixture of argemone and mustard oil, even when the percentage of argemone oil was as low as 5 per cent.

The present writer, however, by adding a known amount of argemone oil, say one c.c. to 20 c.c., of the suspected sample of mustard oil taken in a stoppered flask (I) and taking an equal amount, i.e., 1 c.c. of argemone oil in another stoppered flask as control (II) and by following the technique described by Dr. S. N. Sircar and estimating the picrates in both (I) and (II) and deducting the amount of picrates (II) from the amount of picrates (I) has been able to estimate quantitatively argemone oil in a sample of mustard oil even when the percentage of argemone oil in mustard oil is 0.5 per cent. By taking 40 c.c. of the suspected sample and adding 2 c.c. of argemone oil and taking same quantity, i.e., 2 c.c. of argemone oil as control and using proportionate quantities of reagents, it is even possible to estimate quantitatively with fair degree of accuracy if argemone oil is present in mustard oil upto 0.25 per cent.

Nutrition Workers Meeting in Bangalore

A joint meeting of the Nutrition Advisory Committee of the Indian Council of Medical Research and the Animal Nutrition Committee of Indian Council of Agricultural Research was held at the Indian Dairy Research Institute, Bangalore, on the 29th and 30th June, 1950, under the presidency of Dr. K. C. Sen, Director, Indian Dairy Research Institute, Bangalore.

The members stressed the need for collecting relevant information on the nutritional requirements of human and cattle population in this country and for this purpose appointed a Sub-Committee with Dr. K. C. Sen (*Chairman-Convener*), Dr. V. V. Patwardhan, Director, Nutrition Research Laboratories, Coonoor

(*Secretary*), and 3 other members. It was decided that this Sub-Committee would draft a memorandum to be placed before the Planning Commission in due course detailing the various aspects of this problem and suggesting tentative measures in consultation with the Agricultural and Animal Husbandry Departments of the Centre and various States for the realisation of the targets.

The production of soya bean extract in relation to Agricultural Economy was also discussed, but in view of the fact that adequate documented data on the yields and production of soya bean was not available to the Joint Meeting, it was recommended that the problem of its production in India on a commercial scale be referred to the Agricultural Ministry of the Government of India requesting them to take into account particularly the effect which the cultivation of soya bean will have on relieving or modifying food shortage and on the agricultural economy of the country in general.

Regarding the desirability of solvent extraction of fat from oil-bearing seeds and cakes, the Joint Committee felt the need for a careful scrutiny of the various facts of the problem and appointed for that purpose a Sub-Committee with Prof. B. N. Banerjee of the Indian Institute of Science as convener and six other members, to report on the merits of the case.

Unesco Verdict on Race Discrimination

The United Nations Educational, Scientific and Cultural Organisation (UNESCO) has just made public its authoritative pronouncement on the controversial subject of race.

The main points of the experts' conclusions are:

(1) Racial discrimination has no scientific foundation in biological fact.

(2) The range of mental capacities in all races is much the same. There is no proof that the groups of mankind differ in intelligence, temperament or other innate mental characteristics.

(3) Extensive study yields no evidence that race mixture produces biologically bad results. The social results of race mixtures are to be traced to social factors. There is no biological justification for prohibiting inter-marriage between persons of different ethnic groups.

(4) Race is less a biological fact than a social myth. As a myth, it has in recent years taken a heavy toll in human lives and suffer-

ing and still keeps millions of persons from normal development, and civilization from the full use of the co-operation of productive minds.

(5) But, scientifically, no large modern national or religious group is a race; nor are people who speak a single language, or live in a single geographical area, or share in a single cultural community necessarily a race.

(6) Tests have shown essential similarity in mental characters among all human racial groups. Given similar degrees of cultural opportunity to realize their potentialities, the average achievement of the members of each ethnic group is about the same.

(7) All human beings possess educability and adaptability, the traits which more than all others have permitted the development of men's mental capacities.

International Union of Crystallography

The subjects selected for consideration during the Second General Assembly and International Congress of the Union to be held in Stockholm from 27th June to 3rd July, 1951, are: Instruments and Measurements, New Developments in Structure Determination, Mineral Structures, Metal Structures, Inorganic Structures, Organic Structures, Proteins and Related Structures, Random and Deformed Structures, Thermal Transformations, Crystal Growth and Neutron Diffraction.

The Executive Committee has decided that no report of the Congress shall be published, it being felt that most of the contributions will find their way into the scientific literature in the normal manner and that the expense of separate publication would not be warranted. Full abstracts of the contributions will, however, be distributed in advance; speakers will then be expected to present their papers quite briefly at the Congress in order that ample time may be available for discussion.

It is proposed to hold two Symposia on the following topics: Advanced techniques in Structure Determination; Electron Diffraction in Liquids and Gases. These Symposia are intended primarily for specialist workers in these fields, but in so far as accommodation is available all crystallographers will be welcome. The Symposia will probably be held on the days immediately following the Congress, but one or more sessions may also be arranged during the period 27th June-3rd July. Copies of the Second Circular (September 1950) containing further details, can be had from the General Secretary of the Union, R. C. Evans, Crystallographic Laboratory, Cambridge, England, or

from the Secretary to the Government of India, Department of Scientific Research, North Block, Central Secretariat, New Delhi.

Zoological Society of Bengal

At the Fourth Annual General Meeting of the Society held on August 20, 1950, the following were elected officers and members of Council:—

President: Prof. H. K. Mookerjee, D.Sc., F.N.I.; *Vice-Presidents*: Dr. M. O. P. Iyengar, D.Sc. and Sri. D. D. Mukherji, M.Sc.; *Hony. Treasurer*: Sri. M. M. Chakravarty, M.Sc.; *Hony. Secretary*: Sri. G. K. Chakravarty, M.Sc.

Longest and Shortest Times

The element tellurium 130, formerly thought to be completely stable, has been found by scientists at the Argonne National Laboratory in Chicago to be radioactive with a half-life of about $1\frac{1}{2}$ sextillion years, or about 500 billion times longer than the estimated age of the earth; evidently only an infinitesimal part of the earth's original tellurium has had time to decay.

Tellurium's radioactivity is of a rare type known as double-beta transition, in which two negative electrons are emitted simultaneously from the nucleus of the atom involved. No change in atomic weight occurs and the tellurium becomes xenon 130, a rare gas. The Atomic Energy Commission reports that the longest known half-life was discovered from an excess of xenon 130 in samples of tellurium.

At the other extreme, the same report tells of a half-life of only one tenthrillionth of a second for the neutral meson, which "decays almost as soon as it is formed into two high energy gamma rays," a discovery made at the radiation laboratory of the University of California. The measured half-life of the neutral meson is so short that light itself travels only about one-thousandth of an inch in that time.

(By courtesy of "Sky and Telescope", August 1950, Pp. 249.)

ERRATA

Vol. 19, No. 8, page 233: Note on "A Large Sample Method of Estimating Unemployment in Large Cities".

$$\text{Equation (5): for } Y^2 \left(\bar{x}^2 - \frac{u^2 \sigma_x^2}{n} - \right. \\ \left. \text{read } Y^2 \left(\bar{x}^2 - \frac{u^2 \sigma_x^2}{n} \right) - \right.$$

Line 6 from the bottom: for $\frac{\bar{y}}{z} \Delta z$.

read $\frac{\bar{y}}{z} \Delta z$.

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Current Science

Vol. XIX]

OCTOBER 1950

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THE IRIDESCENT FELDSPARS

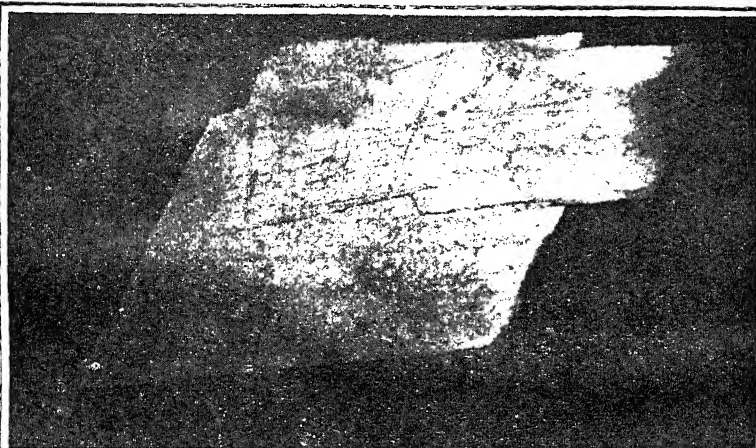
TO the physicist interested in the structure and properties of crystalline solids, the feldspars offer themselves as a fascinating field for study and research. Being a most important group of rock-forming substances, they have naturally been the subject of numerous painstaking investigations by mineralogists. A great volume of data concerning them has accumulated, and much of this awaits interpretation in terms of structural theory. Of particular interest is the optical behaviour of the feldspars. This includes a variety of attractive phenomena for which no satisfactory explanation has hitherto been forthcoming. Amongst them may be mentioned particularly the brilliant play of colours exhibited by the species of feldspar known as labradorite, which is found not only in the locality from which its name is derived, but also in various other parts of the world. Another group of feldspars known as the moonstones has found use in jewellery by reason of a beautiful optical effect known to mineralogists as "schiller" which they display. There are also other types of feldspar

which display characteristic optical effects, e.g., peristerite, murchisonite and amazonite. Labradorite and the moonstones have been the subject of two recent memoirs* published in the *Proceedings* of the Indian Academy of Sciences. Further papers dealing with other types of iridescent feldspars are scheduled to appear in the same journal in the near future. It is felt, however, that the results so far obtained are of sufficient general interest to justify the publication of a review article in *Current Science*, presenting this field of research in its broadest aspects.

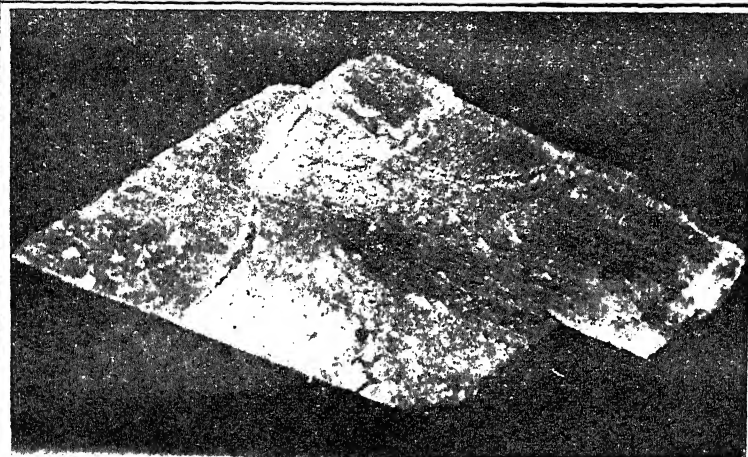
Chemical analysis shows that apart from minor impurities present as inclusions, the commoner feldspars may be regarded as admixtures of three components having a definite composi-

* "The Structure of Labradorite and the Origin of Its Iridescence," by Sir C. V. Raman and A. Jayaraman, *Proc. Ind. Acad. Sci., A.*, 1950, **32**, 1-16.

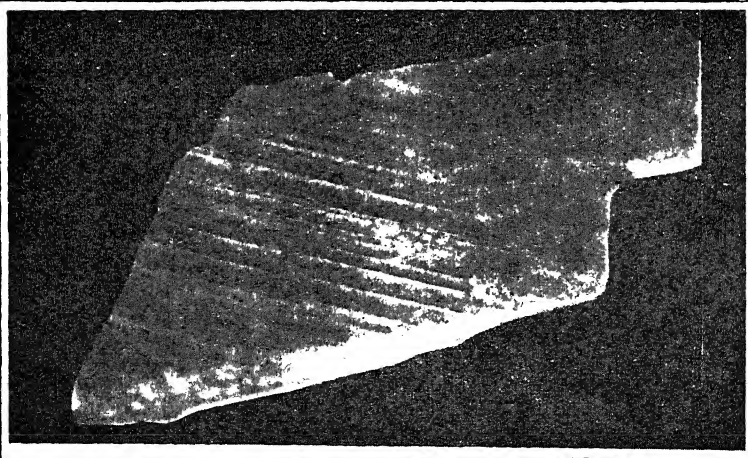
"The Structure and Optical Behaviour of the Ceylon Moonstones," by Sir C. V. Raman, A. Jayaraman and T. K. Srinivasan, *Ibid.*, 1950, **32**, 123-40.



A



B



C

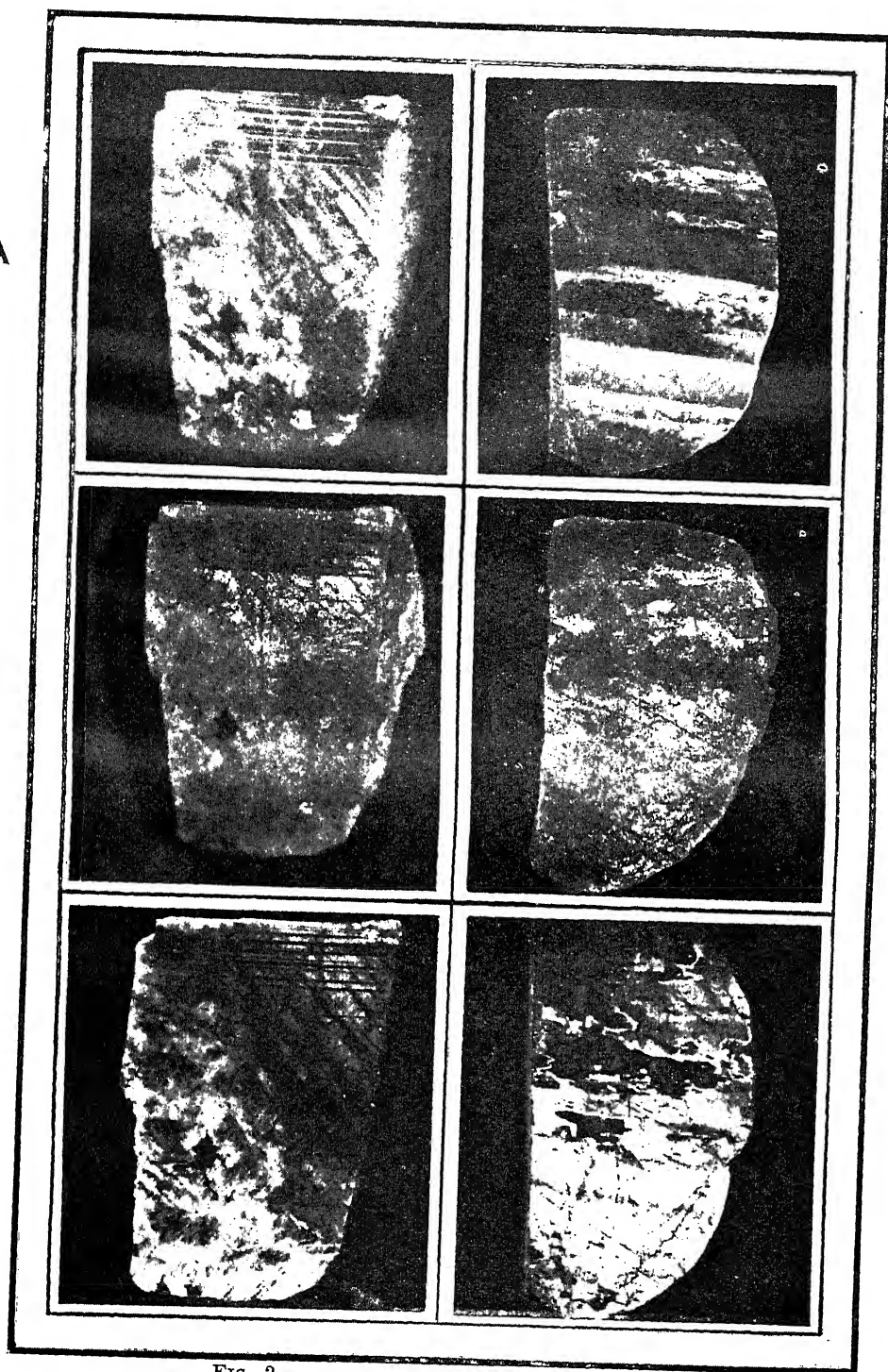


FIG. 2

FIG. 3

tion, namely the potash, soda and lime feldspars. Their mineralogical names and chemical

formulae are respectively orthoclase (KAlSi_3O_8), albite ($\text{NaAlSi}_3\text{O}_8$), and anorthite ($\text{CaAl}_2\text{Si}_2\text{O}_8$).

In their external aspect as well as in the internal structure revealed by X-ray studies, all the feldspars possess certain features in common. Nevertheless, there are important differences. In particular, we remark that while the chemical formulæ of orthoclase and albite are similar, the replacement of the monovalent alkali ion by the divalent calcium ion in anorthite is accompanied by a simultaneous replacement of a silicon atom by an aluminium atom. In spite of such replacement, albite and anorthite resemble each other in their crystal forms very closely, both being triclinic, while orthoclase is a monoclinic crystal. The explanation which has been given for this remarkable situation is that the replacement of silicon by aluminium does not involve any alteration in crystal structure, while on the other hand, the replacement of the larger potassium ion by the smaller sodium or calcium ion results in a definite change of structure.

It has been stated above that a naturally occurring feldspar usually contains all the three components. Their relative proportions, however, vary considerably. Labradorite, for instance, is principally a mixture of albite and anorthite in roughly equal molecular proportions, but contains in addition an appreciable proportion of orthoclase. The Ceylon moonstones consist principally of orthoclase, but include also a substantial proportion of albite and a small percentage of anorthite. In view of the differences in chemical composition and crystal structure of the three components in their pure state, the question naturally arises of the precise nature of their admixture in any particular feldspar as found in nature. In the two papers under reference, it has been shown that the answer to this question is furnished by the optical behaviour of the material under study. In other words, the play of colours exhibited by labradorite, and the schiller of moonstones are alike the optical consequences of the manner in which the component feldspars are distributed within the respective minerals. In the common or macroscopic sense, both labradorite and moonstones are monocrystals. But the passage of a beam of light through the mineral and the diffusion of light resulting therefrom reveal the existence of optical heterogeneity, in other words, of local variations of composition and refractive index. The observed characters of the diffused light, *viz.*, its spectral nature, intensity, state of polarisation and distribution in different directions, and their variations with the setting of the crystal and the direction of passage of light through it, furnish us with the data needed to infer the

nature of the local heterogeneities within the crystal. The explanation of the optical phenomena presented by these feldspars thereby ceases to be a matter for conjecture or specula-

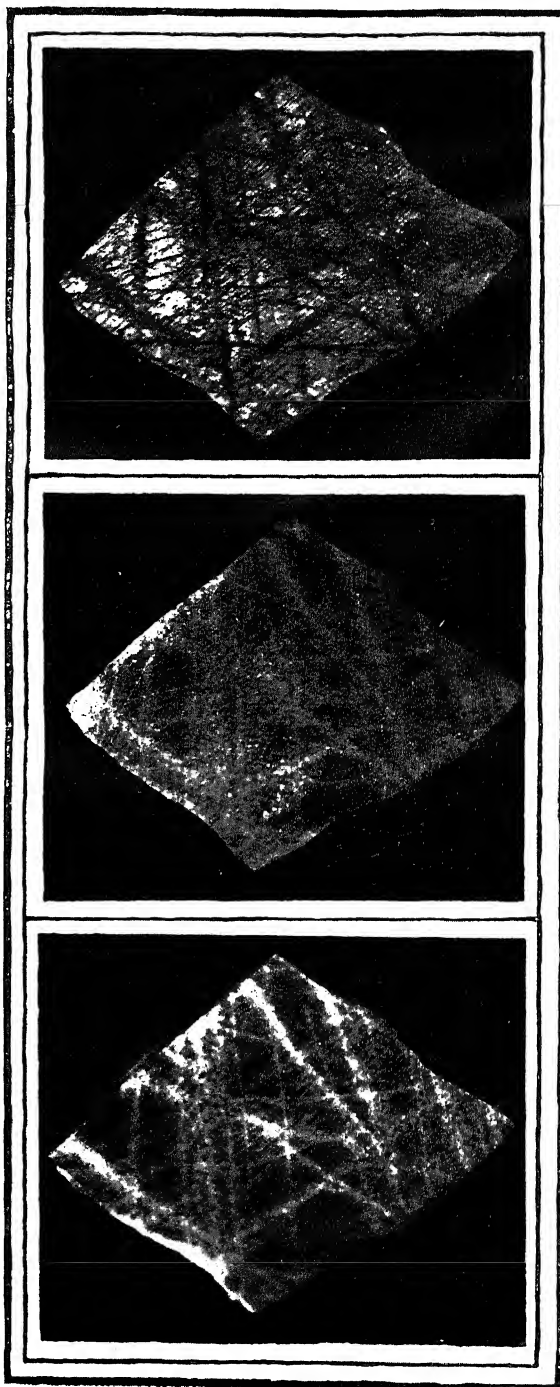


FIG. 4

tion and rests instead on a solid basis of observation and inference.

The optical behaviour of a mixed crystal is, of course, not comparable in all respects with that of a mixture of liquids. Nevertheless, it is useful to indicate the resemblances between the optical phenomena under consideration and the diffusion of light in binary and ternary liquid mixtures. The blue schiller exhibited by the finest moonstones may, indeed, be not inaptly compared in its origin and in its spectral character with the blue opalescence which develops in a binary liquid mixture, e.g., of methanol with carbon disulphide, as its critical solution temperature is approached. The schiller is essentially a diffusion of light within the feldspar. It results from the segregation of the albite from the orthoclase in the form of tiny crystallites which so dispose themselves that the crystalline order and symmetry of the parent mass is left unimpaired. The blue colour exhibited by many specimens of labradorite may similarly be compared with the blue opalescence which develops when water is added to methanol containing benzene in solution, and the benzene tends to separate out in consequence. The diffusion of light in the labradorite which manifests as its iridescence is due to tiny crystallites of orthoclase which have segregated from the albite-anorthite mixture and set themselves in an appropriate orientation within the crystal lattice.

The interested reader will naturally refer to the original papers for further information regarding the topics dealt with above in their barest outlines. They contain a description and discussion of many facts of interest discovered in the course of the studies and which considerations of space preclude even being mentioned here. The illustrations accompanying the present article are taken from the paper on labradorite and represent four of the numerous specimens studied. As the reproductions are not in colour, they are not very effective as pictures of the beautiful phenomena actually observed. But they demonstrate a most important feature of the optical behaviour of labradorite, namely that it shows its characteristic iridescence in *two* different settings of the crystal with reference to the direction of the incident light. These settings (A and C in each figure) lie one on either side of the setting (B in each figure) at which the aventurinism due to the macroscopic inclusions is most prominently displayed. The parts of the labradorite which exhibit the iridescence in the two settings are different, being respectively the alternate layers of multiple twinning in the mineral. The distribution of these layers as well as the nature of the twinning is very different in the four specimens. This becomes evident in the iridescence displayed by them.

C. V. RAMAN.

SYMPOSIUM ON THE HISTORY OF SCIENCE IN S. ASIA

THE Council of the National Institute of Sciences of India, in collaboration with the UNESCO South Asia Science Co-operation Office, propose to hold this year in Delhi a Symposium on "The History of Science in South Asia". The dates provisionally fixed are 5th, 6th and 7th November, 1950.

The Symposium, which will cover the period up to the end of the 18th century, will deal with—

1. (a) Chronology of the achievements;
(b) Defining the periods of achievements;
2. Life stories of the pioneers;
3. Contacts with outside on countries' own

initiative or by the adventurous trips of foreigners;

4. General history of those periods with stress on social conditions;
5. Impact of the discoveries of the scientists on military strategy of the kings and on the general living conditions like town planning, public health, agriculture, transport, industries.

The papers contributed will give either a general integrated picture of scientific development in related branches of science, or a treatment of the progress through the different periods of history of one particular branch of science. They will also bring out the impact of science on society in various periods of history.

WORLD POWER CONFERENCE IN NEW DELHI

MORE than 20 British delegates will be taking part in the second post-war sectional meeting of the World Power Conference which is to be held in Delhi next January. Many of the delegates will also be attending the meetings of the International Commission on Large Dams which will hold its fourth Congress at New Delhi at the same time.

Among the British delegates will be Sir Vincent de Ferranti who has recently succeeded Sir Harold Hartley as Chairman of the International Executive Council and the British National Committee of the W.P.C.; Lord Citrine, Chairman of the British Electrical Association; Sir Arthur Fleming, of Metropolitan-Vickers Company; Mr. J. W. Warnock, hydro-electric engineer; and Dr. E. C. Fairhead, of Imperial Chemical Industries, Ltd.

Next year's Conference will have as its theme the "Utilisation of Power in its Various Aspects" and it is hoped that it will produce much valuable information on the development and use of power for the production of food and essential industries throughout the world. Some of the subjects on the agenda deal with such

aspects of this theme as "Utilisation of Electricity in Agriculture and Agricultural Processing", "Electricity and Fertilisers", and "Power and Mines".

India has one of the most comprehensive irrigation systems in the world—the acreage under irrigation in India actually exceeds the combined total acreage irrigated in the U.S.A., the U.S.S.R., Japan, Egypt and Italy. Representatives from 32 nations have been invited to the Conference and various non-member countries of Asia will be sending unofficial delegates.

A special feature of the Conference will be an international exhibition arranged by the National Committee to demonstrate engineering activities relating to the utilisation and conservation of water power and allied research. The exhibition will include working and still models of river valleys and power works and will last for at least one month.

The Conference itself will remain in session for a week from January 10 to 15, but there will be opportunities for the delegates to take part in both pre- and post-Conference study tours of places of special interest.

GEOLOGY AT ALIGARH

A DEPARTMENT of Geology has been created at Aligarh University and Dr. P. N. Ganju has been appointed Reader and Chairman of the new department. Dr. Ganju has recently returned from King's College, Durham University, where he specialized in coal petrology.

The importance of trained geologists in India needs no emphasis; a great deal remains to be

done in developing and exploring the mineral resources of this vast country. But at the moment very few Indian universities have well-equipped geological laboratories and perhaps none is equipped for research in coal petrology. Dr. Ganju's appointment will help to initiate research in this new and essential field so indispensable for the investigation of our coals and coal fields.

DR. R. R. WILLIAMS VISITING INDIA

DR. R. R. WILLIAMS of the Research Corporation of America, well known for his synthesis of vitamin B₁ and, till recently, Director of Research of the Bell Telephone Laboratories, is shortly undertaking a tour of South Asia, primarily to study the rice economy and practices of the rice-eating countries, to develop further knowledge of the extent of vitamin deficiencies and the applicability, for their correction, of undermilling, parboiling or

artificial fortification methods. Dr. Williams will be in India during November 13 to December 13 under an appointment as Consultant to the U.S. Public Health Service and under the auspices of the Williams Watermann Fund for Combat of Dietary Diseases. While in India, Dr. Williams will visit important research centres including Bombay, Delhi, Calcutta, Cuttack, Madras, Bangalore, Mysore and Coonoor as well as his birth-place Nellore.

WORLD AGREEMENT FOR ABOLISHING DUTIES ON SCIENCE EQUIPMENT, BOOKS AND FILMS

SCIENTIFIC instruments, apparatus and collections intended for education or research will enjoy duty-free entry under a new international agreement which UNESCO is sponsoring as a means of reducing barriers to world trade in educational, scientific and cultural materials. The text of the convention was approved by UNESCO's 59 Member States attending the recent General Conference of the Organization in Florence.

The "Agreement on the Importation of Educational, Scientific and Cultural Materials" will also permit the free import of books, newspapers, periodicals, maps and charts. To aid their circulation further, contracting Governments will grant licenses and foreign exchange for publications consigned to public libraries. A special article in the convention provides for the duty-free entry of all books and other educational material for the blind.

Duties will also be lifted from educational, scientific or cultural films, filmstrips, newsreels and sound recordings. Paintings, drawings and sculpture will likewise be freed from tariff restrictions.

Scientific instruments and apparatus will enjoy exemption provided, firstly, they are intended solely for educational or research purposes and are destined for recognized educational or scientific institutions; secondly, that materials of equal scientific value are not already being manufactured in the importing country. Other materials which will be admitted duty-free, if consigned to approved institutions, include patterns, models and wall charts; and architectural, industrial or engineering plans and designs.

UNESCO is circulating the convention to all its Member States, and to Members of the United Nations. It will be open for signature at Lake Success, New York, shortly and will come into force following ratification by ten countries.

The United Kingdom Government has announced that it will submit the text to Parliament for ratification. Belgium, France, Luxembourg, the Netherlands and Switzerland are among other countries which are expected to take quick action for legislative approval.

Following its adoption at Florence, the Director-General of UNESCO, Dr. Jaime Torres Bodet, said the new world pact represented a substantial contribution, in the technical field, to mutual understanding and peace. He urged swift action to bring it into force.

This is the second international agreement to be sponsored by UNESCO. The first, which is designed to abolish duties, quotas and licenses hindering the movement of films, recordings and other audio-visual aids to education, has now been signed by 18 countries and ratified by three (Norway, Yugoslavia and Pakistan).

Both conventions are expected to be of considerable aid to importers and exporters in countries taking part in UNESCO's International Coupon Scheme, since they will lift tariff and other restrictions on materials which the scheme covers—books, periodicals, scientific materials and educational or scientific films. This plan, which was initiated as a book scheme in December 1948, has been extended to scientific materials and films since January 1950. It enables institutions or individuals in soft currency countries to buy these items from hard currency countries, while making payment in their own national currency.

Nineteen countries are now taking part in the book phase, ten in the scientific materials phase and twelve in the film phase of the scheme. Scientific material purchased is for the time being limited for the use of educational and scientific institutions. A leaflet issued by UNESCO gives a list of materials in 11 categories that can be bought, together with the addresses of suppliers. These materials include chemicals, glass and porcelain.

—By courtesy of UNESCO.

GROUND TRAFFIC CONTROL FROM THE AIR

THE utility of the "mobilophone" service was demonstrated on the occasion of the 25th Anniversary of the Dutch Broadcasting Association at Hilversum. A fixed mobilophone set was stationed at Police Headquarters, while 6 mobilophone-equipped cars drove through Hilver-

sum to report possible traffic jams. In addition, a sports-plane equipped with Philips mobilophone cruised above Hilversum, to give instructions, also from the air. In this way the entire traffic control could take place from one central point (Police Headquarters).

FISH CULTIVATION IN OPEN SEA-LOCHS

NOTHING is of greater interest to chronically under-nourished countries facing persistent food shortages over a period of years than successful methods of cultivating food materials of whatever kind on every available inch of land or water. During World War II, well-regimented Great Britain, faced with the prospect of starvation consequent on its lines of sea communication with the rest of the world being cut, not only encouraged all possible economy and means of prevention of waste in food conservation, storage, and distribution, but stimulated new methods of production from the natural resources within the country.

A group of zoologists of the Edinburgh University carried out experiments, with liberal financial grants from the Imperial Chemical Industries, Ltd., in applying fertilizers to the Scottish sea-loch, Loch Craigin, with the object of testing "the possibility of increasing fertility of a small sea-loch by the addition of nitrate and phosphate fertilizers, with a view of improving the growth rate and yield of fish." The results of the experiments were sufficiently encouraging not only to deserve publication,* but also to justify an extension of the work to a larger area of Loch Sween, of which, Loch Craigin formed only a very small and atypical part. Kyle Scotnish, a much larger area of Loch Sween than Loch Craigin, in which the extension work was carried out, had certain advantages, (1) in having a sufficiently large volume of water to reduce the extreme fluctuations in salinity, pH, and other factors encountered in the previous experiments, (2) in having sufficient depth to reduce the proportion of seaweed to phytoplankton in the productivity of the cultivated area, (3) in having its connections with the main loch intact to enable tests of possibilities of fertilizer application to open, instead of artificially enclosed, sea-lochs being carried out.

The results of the extension experiments, like those of the original experiment, though concerned primarily with the scientific rather than the economic problems of marine pisciculture, were considered to be of sufficient im-

portance to form a series of five articles in a recent issue of the *Proceedings of the Royal Society of Edinburgh*, LXIV, B. Part I, 135 pp. (1949-50). These articles deal with the hydrographic factors, the plankton, the bottom fauna, and the growth of fish in Kyle Scotnish under the fish cultivation experiments carried out in this arm of Loch Sween. Following the application of fertilizers (superphosphate, sodium nitrate, or ammonium sulphate) to Kyle Scotnish with its connection with the main loch left open, one and a half million eggs and fry of plaice and flounders obtained from an adjoining hatchery were released in 1945-46 and their growth observed. The experiments have shown that these fish grow three to four times as fast as the fish in normal grounds. The results of the experiments do not throw any light on whether marine cultivation can be made to pay, but before properly planned experiments dealing with the economic aspects can be carried out it seemed essential to the sponsors of these experiments to gather much more information "regarding the chain of events following the application of fertilizers, the magnitude of the response of the different plant and animal communities, and the growth-rate and migratory movements of fish in an open area".

There is a crying need for such experiments being carried out in our coastal lagoons and backwaters in India even in these times of tight financial conditions, because area for area water appears to be more responsive to fertilizer treatment than land and to offer better chances of higher yields over a longer period of time with less labour and capital than are required for land cultivation. It is unfortunate that the chronically starved biological research organizations of our Universities and under the control of our States and Central Governments have to wait indefinitely for better times to follow the lead given by Great Britain and other countries.

H. SRINIVASA RAO.

* *Proceedings of the Royal Society of Edinburgh*, B. 63, (1), 1947; *Journal of the Marine Biological Association, Plymouth*, 28, Part I, 1949.

FELLOWSHIP AWARD

DR. K. K. MAJUMDAR, M.Sc., D.Phil. (Cal.), A.R.I.C. (Lond.). Senior Lecturer in Mineral Dressing, Indian School of Mines and Applied Geology, Dhanbad, has been awarded the William Campbell Fellowship by the Columbia University, New York, and the Fulbright Travel

Grant by the U.S.A. Government. Dr. Majumdar will carry on researches on flotation of minerals under Prof. A. F. Taggart in the Department of Mineral Engineering in the Columbia University.

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SUPPRESSION OF HIGH FREQUENCIES
IN THE PRODUCTION OF JOSHI
EFFECT

A REVIEW of the now considerable literature on this phenomenon shows, (1) the presence in the discharge current of numerous frequencies much higher than that of the exciting field;¹ (2) exposure of the discharge tube to light causes a current decrease, $-\Delta i$ (the negative Joshi Effect), and (3) which predominates in the H.F.'s.^{3,5,6,9} No satisfactory explanation is forthcoming for (3). The mechanism of Klemenc, *et al.*² for H.F. production in the ozoniser discharge cannot explain Joshi Effect, since it does not anticipate the occurrence of the positive effect, negative temperature coefficient, the influence of the nature of the gas and of 'ageing'.⁹ The boundary complex theory

(*vide infra*) gives a more detailed mechanism of the working of the boundary layer, postulated by Joshi⁹ as the chief seat of the effect, and is not inconsistent with the findings of Klemenc, Hintenberger and Hoffer.² It is suggested that (4) the formation of a single-bonded^{10,11,12} polarised wall complex, $W^{+\frac{1}{2}}(XY)^{-\frac{1}{2}}$ is a primary step, where W denotes the wall molecule and XY the gas molecule from the discharge space which can accept normally or under excitation an electron donated by W; (5) under the applied fields the complex ionises: $W^{+\frac{1}{2}}(XY)^{-\frac{1}{2}} \rightarrow (WXY)^+ + e(-)$; (6) light dissociates it into neutral particles (a) $W+XY$, (b) $WX+Y$ or/and particles (a) $W+XY$, (b) $WX+Y$ or/and negative ions, (c) W^++XY^- , (d) WX^++Y^- instead of electrons in (5); the latter causes a

current decrease represented by negative Joshi Effect. On this view electrons initiate the current in dark and negative ions do so under light. Thus there are in the two cases (5) and (6) differences in respect of velocity and number of current carriers and the ionising power of the current initiators, viz., electrons in (5) and negative ions in (6). This accounts for the photo-diminution, — Δi .

On this basis, the suppression of the associated H.F.'s, in terms of Klemenc, *et al.*'s theory originates as follows: Comparatively, a greater proportion of surface charges is formed with free electrons in dark. Under light from (6) neutral particles or/and negative ions are released, these last possess a markedly lower ionising efficiency. The corresponding surface charges produced will consist chiefly of negative ions and electrons. Their neutralisation, therefore, would yield weaker pulses under light than in dark, where the surface charge density is greater due to presence of free electrons (with their more intense ionising power) from (5). The reduced strength of the H.F.'s under light, therefore, follows.

We can view the problem from another standpoint. An ozoniser can be considered as a condenser¹ discharging internally. Under light the ionisation is reduced; the corresponding capacity and especially resistance become greater than in dark. A decrease in frequency should, therefore, follow since to a first approximation $f = (1/2\pi) \cdot \sqrt{(1/LC - 4R^2/L^2)}$, where f denotes not the resonant frequency but Σf the equivalent frequency.⁴ Joshi observed^{5,7,8} that $-\Delta i$ is reduced numerically by the introduction of a serial resistance in the circuit, which was ascribed by him to a preferential damping of the H.F.'s. This last should also occur under light since i diminishes, indicating increase in resistance.

We wish to express our gratefulness to Prof. S. S. Joshi, Principal, Science College, Hindu University, Banaras, for encouragement and help in writing this note.

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RADIATION CORRECTION AND THE LAW OF COOLING

In a recent note, Gupta¹ has compared the relative rates of heat loss by a cooling body as calculated from the Stefan's Law on the supposition that the body behaves as a perfect black body and that from Newton's Law of cooling. He finds that, for a difference of temperature of about 5° C. between the body and the surroundings, the contribution of radiation loss is about 75 per cent. and of convection about 25 per cent. The experiment was performed by suspending a calorimeter inside a bigger vessel by means of threads.

We have performed the experiment under different conditions. A calorimeter was supported inside a double-walled bigger vessel by means of an ebonite disc having a central hole and covering the bigger vessel. The enclosure temperature was kept constant by keeping water flowing through the outer jacket. In order to minimize the temperature gradients in the upper parts of the walls, the calorimeter was filled with water to the same level, nearly to the top, in all the experiments. Table I shows the results obtained.

TABLE I

Temperature of the absorbing surface	Rate of loss of heat at			Nature of the surfaces	
	43°C.	40°C.	38.6°C.	Cooling	absorbing
(i) S 34.3°C N	64630 75730	41570 45810	29540 31340	dull white	dull black
(ii) S 33.0°C N	69164 54890	41751 33920	39966 26360	unpolished	unpolished
(iii) S 32.2°C N	75587 59570	53909 39970	44389 39660	polished	unpolished
(iv) S 33.0°C N	69164 74980	41751 43550	39966	dull black	unpolished

S = Stefan's Law (calculated) ergs/sec/cm²/T⁴

N = Newton's Law (experimental) ergs/sec/cm²/T

It is found that in no case do the values, for the relative rates of heat loss calculated from

Stefan's Law and those found experimentally by applying Newton's Law of cooling, agree. The term 'radiation correction' as used in connection with such experiments in calorimetry, therefore, seems basically wrong and misleading; instead 'cooling correction' should be the proper term used. It is further seen by comparing the cases (i) and (iv) with (ii) and (iii), that the rate of loss of heat is much more in the former case than in the latter. It is therefore advisable to keep the cooling surface dull instead of polishing² it for quicker cooling. It is also apparent that taking the convection loss to be the same at a particular temperature (though it is different at different temperatures) in all the cases, the loss by radiation depends on the nature of the cooling as well as the absorbing surfaces. It is therefore desirable to define the specific conditions under which the Newton's Law of cooling experiment be performed.

We are thankful to Dr. H. R. Sarna for his kind encouragement and guidance.

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ELECTRO-DEPOSITION OF METALS AND ALLOYS FROM CYANIDE-FREE BATHS

Part II. Copper from Ethanolamine Solutions

In a previous communication from this laboratory,¹ it has been shown that the complex silver iodide bath gives electro-deposits of silver comparable to those from the silver cyanide bath. The present investigation deals with a similar attempt to obtain a suitable substitute for the commercial cyanide bath for the electro-deposition of copper, in view of its poisonous nature and instability.

Copper has been electro-deposited on steel from baths containing copper salt-ethanolamine complexes: (1) Copper oxalate-monoethanolamine, (2) copper oxalate-diethanolamine, and (3) copper oxalate, nitrate, citrate, tartrate, carbonate-triethanolamine. These baths are simpler than those attempted before.^{2,3,4,5} As in the cyanide bath, immersion deposition is prevented by complex formation which reduces the effective copper (cupric) ion concentration. The latter has been determined by the E.M.F. method and is found to be of the order

1×10^{-33} to 10^{-35} N. A detailed study has been made of the effect of variation in (a) concentration of copper, (b) concentration of ethanolamine and (c) c.d., on the electro-deposition. The bath is comparable to the cyanide bath in respect of cathode efficiency, c.d. range, rate of deposition and brightness, adherence and general quality of the deposit. The cathode efficiency is nearly 100 per cent., except in the copper nitrate-triethanolamine bath, which gives lower values.

Rochelle salt, as a constituent of the copper oxalate-monoethanolamine bath, improves anode corrosion, increases the c.d. range, conductivity, cathode polarisation and throwing power, and yields better quality deposits by eliminating treeing and increasing the brightness. The optimum conditions for the various baths are given in the following table:

TABLE I
Bath Voltage 1.2 to 5.5 Volts

Copper salt (g./L)	Ethanolamine (c.c./L)	pH	Temperature °C.	Bright c.d. range (amp./dm ²)
(a) Oxalate 60 + Rochelle salt 60 g./L. (mono-)	60	9.5	24	2.4 -4.8
(b) Oxalate 45 + Rochelle salt 45 g./L	(di-) 68	9.0	24	1.2 -1.6
(c) " 60	(tri-) 150	8.1	24	0.68-2.0
(d) Nitrate 45	(tri-) 135	8.3	24	0.64-1.6
(e) Nitrate 45	(tri-) 135	8.3	40	1.2 -3.6
(f) Citrate 30	(tri-) 150	9.3	24	0.4 -1.12
(g) Tartrate 45	(tri-) 135	8.6	24	0.24-0.8
(g) Carbonate 45 + Ammonia (24%) 50 c.c./L.	(tri-) 135	9.5	24	1.2 -2.0

Higher temperatures are not conducive to proper working, except in the copper nitrate-triethanolamine bath. The effect of addition agents has been studied. A substantial improvement in the performance of the bath and the quality of the deposit has been noticed with some addition agents. The pH, conductivity and cathode polarisation have been measured. The throwing power, as calculated from c.d.-cathode potential curves is not as good as that of the cyanide bath.

The copper salt-ethanolamine baths have some important advantages over the cyanide bath, in respect of higher cathode efficiency, ability for good working at room temperature, brightness of deposits and improved performance with certain addition agents. In some

cases, a higher current density range has been found to operate. These baths, therefore, appear to be promising substitutes for the cyanide bath used in the electro-plating industry.

Our thanks are due to Prof. B. Sanjiva Rao, Head of the General Chemistry Section, for giving all facilities and taking interest in the work.

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N⁴-(BIGUANIDYL-SUBSTITUTED)-N¹-BENZOYL SULPHANILAMIDES

CONSIDERING the interesting results in malarial chemotherapy, which have been noticed by Bami, Iyer and Guha¹ working in the field of N⁴-substituted sulpha-biguanides, it was thought worthwhile to extend this field to include the highly active N¹-sulphanilyl-benzamide in view of the observation made by Sen Gupta,² *et al.* and Bose and Ghosh³ that N¹-benzoylsulphanilamide possesses high antibacterial activity against certain strepto- and staphylo-infections *in vitro*, besides possessing high chemotherapeutic activity against Flexner organism and a very low toxicity. Bami, *et al.* have reported that some of the sulpha-biguanides possess suppressive antimalarial activity "when tested at relatively large doses" though not coming upto the standard of either paludrine or quinine.⁴

It was, therefore, considered desirable to study the influence of a substituted biguanide molecule attached to the N⁴-position of N¹-benzoyl-sulphanilamide.

Some N⁴-substituted biguanidyl-N¹-benzoyl-sulphanilamides of type (I) have now been synthesised for studying their effect against malarial and certain coccal infections.

$\text{RNH}-\text{C}(=\text{NH})-\text{NH}-\text{C}(=\text{NH})-\text{NH}-\text{C}_6\text{H}_4-\text{SO}_2\text{NHCO.C}_6\text{H}_5$ (where R=H—, substituted Type I aryl—*etc.*)

The compounds have been prepared by refluxing N¹-sulphanilyl-benzamide hydrochloride with the appropriate cyanoguanidines in pyridine medium (ethanol unsuccessful) for 3-8 hours. All the sulpha-biguanides have been isolated and characterised as white powdery hydro-

chlorides, some being crystallisable from organic solvents; others being uncrystallisable could only be purified by removing the starting materials with suitable solvents. The compounds are amphoteric in nature. All the sulpha-biguanides (*vide* Table) excepting compound No. 4, get decomposed while melting.

No.	R in compounds Type I	M.P., °C.
1	H—	240-41
2	C ₆ H ₅ —	264
3	<i>p</i> -Cl-C ₆ H ₄ —	215-16
4	<i>m</i> -Cl-C ₆ H ₄ —	239
5	<i>p</i> -Br-C ₆ H ₄ —	266-68
6	<i>p</i> -I-C ₆ H ₄ —	230-32
7	<i>p</i> -CH ₃ O-C ₆ H ₄ —	213-14
8	<i>p</i> -CH ₃ -C ₆ H ₄ —	225-26

Full details will be published elsewhere.

We are indebted to the Indian Council of Medical Research for the award of a Fellowship to one of us (P. R. Gupta) and also to Messrs. Bengal Immunity Co., Ltd., Calcutta, for the gift of sulphanilyl benzamide.

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THE NUCLEAR OXIDATION OF COUMARINS

In the course of the investigation requiring intermediates for the fluorescent azo dyes, we undertook the systematic oxidation of certain coumarin derivatives by the alkaline potassium persulphate method of Elbs.¹ This method has been used by Bargellini and Monti² to oxidise two coumarins, and by Seshadri and co-workers³ to oxidise the flavones. As the hydroxy-coumarins failed to give any definite crystalline products, we have used their methyl ethers in pyridine solution and obtained definite results with the following coumarin derivatives.

(1) Coumarin, (2) 7-methoxy-4-methylcoumarin, (3) 5-methoxy-4:7-dimethylcoumarin, (4) 5:7-dimethoxy-4-methylcoumarin, (5) 6:7-dimethoxy-4-methylcoumarin, (6)

7: 8-dimethoxy-4-methylcoumarin, (7) 6-methoxy-4-methylcoumarin and (8) 4-methyl-1: 2- α -naphtha-pyrone. All of them underwent oxidation with the insertion of the hydroxyl group in 6-position. Where this position was occupied, either the oxidation did not proceed or some abnormal reaction took place. These methoxy-hydroxy-coumarins could be demethylated smoothly with the formation of the unknown 5: 6-dihydroxy-4-methylcoumarin, 5: 6: 7-trihydroxy-4-methylcoumarin, and 6: 7: 8-trihydroxy-4-methylcoumarin. We have applied this method for the synthesis of the natural coumarins scopoletin, fraxinol and fraxetin. Fuller details will be shortly published elsewhere.

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ADSORPTION OF HYDROGEN AT ELEVATED PRESSURES ON A PROMOTED IRON SYNTHETIC AMMONIA CATALYST

A static volumetric method, an improvement on that employed by Frolich and White,¹ has been developed for the measurement of adsorption of gases by solids at elevated pressures. Employing this method, the adsorption of hydrogen has been studied on a Fe — K₂O — Al₂O₃ — TiO₂ catalyst at seven temperatures ranging from 50° to 350° C. and at pressures from 15 to 50 atmospheres.

The results obtained indicate two distinct types of activated adsorption of hydrogen in the temperature range studied, one showing a maximum at about 150° and the other at about 300° C. Emmett and Harkness² have found two types of activated adsorption of hydrogen on a doubly promoted iron catalyst, Type A occurring fairly rapidly between -78° and 0° C. and Type B at 100° C. Presuming that, in conformity with this observation, the present catalyst can also give rise to Type A adsorption and that the maximum found at 150° C. corresponds to the Type B chemisorption, the maximum at 300° C. noted in the present investigation therefore points to the occurrence of a third type of activated adsorption which may be designated as Type C. The occurrence of three different types of activated adsorption of hydrogen on iron can be explained on the basis of the 3-fold

disposition of the iron atoms in the (111) crystallographic plane of the body centred cubic lattice of α -iron (Fig. 1 of Ref. 3).

The surface area of the catalyst as found by applying the B.E.T. equation¹ to the adsorption of argon on the reduced catalyst at liquid air temperature was 1.85 sq. m. ($V_m = 0.48$ cc.) per g. of unreduced catalyst. Assuming that in this determination the argon atoms were adsorbed only on the plane of the outermost iron atoms, while in the activated adsorption of hydrogen every iron atom of the surface, in any of the three possible dispositions, could chemisorb a hydrogen atom, an estimate could be made of the maximum adsorption of hydrogen on the part of the surface consisting of free iron atoms, which according to Brunauer and Emmett³ cover roughly 40 per cent. of the total surface of a doubly promoted catalyst. The results show that beyond about 100° C., the adsorption exceeds the calculated surface saturation limit (0.4 cc./g.) at fairly high pressures. This indicates that especially at the higher pressures, there is marked absorption into the metal lattice. Further proof of the superposition of absorption on chemisorption is provided by the rather low values obtained for the heat of adsorption. For an adsorption of 0.2 cc./g. a value of 4,746 calories per mole is obtained for the heat of adsorption as against 8,500 calories per mole obtained by Emmett and Harkness.²

The authors are very thankful to Sir J. C. Ghosh for having given an inspiring lead to the present investigation and to Prof. B. Sanjiva Rao for his kind interest and encouragement.
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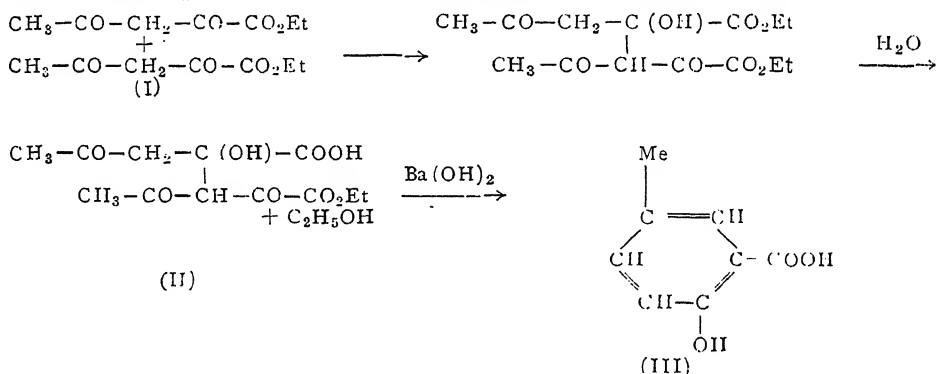
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FORMATION AND NEW METHODS OF PREPARATION OF 3-ACETYL-4-CAR- BOXYLIC HEPTANOL-4-DIONE-2-S CARBOXYLIC MONOETHYL ESTER-1

In the study of hydroxy and ethoxy methylene derivatives of substituted pyruvic ester, an attempt was made to prepare ethoxymethylene acetyl pyruvic ester (I) by Claisen's orthoformic ester and acetic anhydride method.¹ After removing acetic anhydride, the residual

oil, on distillation under reduced pressure gave unchanged acetyl pyruvic ester every time. In one such experiment the aqueous layer which was lying in a dish gave in 4-5 hours a good crop of crystals adhering to the gummy matter. They were separated mechanically on a porous tile and melted at 89-90°C. The analysis did not correspond to any of the expected reaction products of acetyl pyruvic ester and orthoformic ester. The melting point indicated it to be different from acetyl pyruvic ester (m.p. 10°C.). It was thought, therefore, to be a self-condensation product of acetyl pyruvic ester.

On reference to the literature, it was found that a compound, m.p. 91°C., was prepared by Claisen and Stylos² from acetyl pyruvic ester by a lengthy process. The sodium compound of (I) when shaken with glacial acetic acid and the crystalline precipitate thus obtained on treating with excess of dilute sulphuric acid gave (II), which with baryta water on water bath gave 5-oxy-3-methyl benzoic acid (III) [cf. Meldrum and Perkin.³]



In view of our observation, this lengthy process is not necessary. The compound (II) is formed in good quantity when distilled acetyl pyruvic ester is mixed with a little acetic acid and exposed to air in an open vessel or if undistilled acetyl pyruvic ester prepared according to Claisen,⁴ containing traces of acid is simply exposed to atmosphere in contact with water. It behaves as a monobasic acid of the composition $\text{C}_{12}\text{H}_{16}\text{O}_8$ (cf. Claisen, *loc. cit.*) and proved identical with the compound prepared by Claisen's method by mixed melting point and the results of analysis. It is formed by a simple condensation of two molecules of acetyl pyruvic ester.

Since acetyl pyruvic ester self-condenses spontaneously in presence of acids, the Claisen's method (*loc. cit.*) for preparation of ethoxy or hydroxy methylene compound cannot be used. Also, since it forms its own sodium derivative

with sodium ethoxide the Claisen's method,^{5,6} using formic ester is not available. Weak bases (Knoevengal⁷) like the diethylamine, aniline, piperidine were tried as condensing agents in combination with formic ester. The first two gave the diethylamide and the anilide of the ester itself. With piperidine and formic ester however the self-condensation products of acetyl pyruvic ester is again obtained in quantitative yield, extremely pure (cf. Kaushal).⁸ Thus, formic ester does not combine with acidic or basic condensing agents with acetyl pyruvic ester on account of the great tendency of self-condensation of the latter.

Preparation of 3-acetyl-4-carboxylic heptan-4-one-2 : 6-carboxylic monoethyl ester-1 (II): Method 1.—Acetyl pyruvic ester 2g and 4-5 ml. acetic anhydride are heated together for 5 minutes and the mixture poured on watch glass, when in about half an hour crystals begin to separate. Recrystallised from acetone-water in long colourless needles, m.p. 90°C.

Method 2.—Acetyl pyruvic ester 5 g. and piperidine 4 ml. are mixed when much heat is

evolved. The colour changes to deep red. The mixture is gently warmed and kept for 2-3 days. It is then acidified to neutralise piperidine, when in about 10 minutes crystals begin to separate. It is left in a dish for slow crystallisation when colourless shining needles are obtained, m.p. 92°C. In this case, the crystals are quite free from the adhering gum; the yield is 100 per cent. and the product was quite pure and it did not need any further purification. (According to experiment C = 50.5, H = 5.2 per cent. and E = 270, whereas $\text{C}_{12}\text{H}_{16}\text{O}_8$ requires C = 50.0, H = 5.6 per cent., and E = 288).

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ACCUMULATION OF CHOLESTEROL IN INOSITOL-DEFICIENT LARVAE OF *CORCYRA CEPHALONICA* St.

SLADE,¹ and Kirkwood and Phillips,² found that the growth of *saccharomyces cerviseae*, was inhibited by the gamma isomer hexachlorocyclohexane (gammexane), due to its anti-inositol activity. Williams and Lane³ have shown that inositol occurs in equimolecular proportions in purified α -amylase from pork pancreas and that gammexane inhibits amylolytic activity in a manner reversible by an excess of inositol. These findings, however, have been challenged by Fischer and Bernfeld,⁴ who could not detect inositol in purified preparations of α -amylase from pig pancreas and from human saliva; nor could they find any inactivation by gamma hexachlorocyclohexane.

In the course of our studies on the enzymic role of inositol, it was found that gammexane retards the growth of rice moth larvæ (*Corcyra cephalonica* St.), and further, that this retardation was counteracted by the addition of either inositol or phytin to the diet. Estimation of amylase activity in the acetone dried tissues of larvæ, grown in the various diets, did not show any striking differences in the larvæ fed on either gammexane singly or on a mixture of gammexane and inositol in comparison with the controls. However, a marked accumulation of cholesterol was observed in the tissues of inositol deficient rice moth larvæ, while no such increase was observed when inositol or phytin was added to the gammexane diet.

The technique of rearing and employing the larvæ as the test organism is essentially the same as described earlier.⁵ Ten-day old larvæ, fed on wheat bran, were placed in petri dishes containing adequate amounts of the following diets. The basal diet consisted of a mixture of wheat flour (2 parts) and tapioca (1 part) granulated and dried at 50° C. Gammexane, a 90% pure gamma isomer of hexachlorocyclohexane, dissolved in benzene was mixed with the basal diet at different levels in order to find the optimum concentration for inhibition of larval growth. It has been found that a concentration of 2 mgm. per cent. of gammexane in the diet retards larval growth and that this inhibition is counteracted by the addition of either 500 mgm. of phytin (calcium salt), or

100 mgm. of inositol in 100 grams of the basal diet. Typical data is given below for larval growth in milligrams for ten larvæ:—

TABLE I

Days	Weight of 10 larva expressed in milligrams				
	0	7	15	25	32
A. Basal diet + 2mgm. of gammexane in 100 gm. of diet ..	14.9	25.0	52.5	60.8	84.0
B. Same as A + 100 mgm. of inositol ..	..	..	Transferred 52.5	90.6	167.0
C. Basal diet ..	13.9	38.0	107.3	200.2	267.0

Amylase activity of acetone dried larval tissue was estimated by the method of Somogyi⁶; its cholesterol content was determined by the micro method of Schoenheimer and Sperry described in Hawk, Oser and Summerson,⁷ using the Lumetron photoelectric colorimeter. The results were given in Table II.

TABLE II

Cholesterol content and amylase activity of
larval tissue

	No. of larvæ used	Wt. for 10 larvæ mgm.	Amylase activity ml. of N/200 Na ₂ S ₂ O ₃ per mgm. of enzyme powder	Cholesterol cont. mgm./100 gm. of larval tissue
A. Basal diet ..	10	281.6	5.03	102.4
	15	245.0	5.09	93.6
B. Diet A + 2 mgm./per cent. of gammexane	75	58.0	4.83	216.4
	50	47.5	5.00	245.0
C. Diet B + 500 mgm./per cent. of phytin	25	210.3	4.85	80.6
	15	185.8	4.77	116.0
D. Diet B + 100 mgm./per cent. of inositol	30	182.9	4.90	121.5

The data show, (1) there is little difference in the amylase activity of tissues of larvæ raised on different diets; (2) there is a marked accumulation of cholesterol in the larvæ fed on "gammexane diet"; (3) the cholesterol content of larvæ fed on phytin or inositol diet is of the same order as that normally present in larvæ raised on the basal diet. Cholesterol accumulation has not so far been reported in any organism in inositol deficiency, though Herrmann⁸ reports that in aged hens, tissue cholesterol is demobilized on feeding them with inositol.

Further investigations are in progress. Thanks are due to Dr. W. H. Tisdale of E.I. Du Pont De

Nemours and Co., Inc., Wilmington, Delaware, U.S.A., for the gift of gamma isomer of hexachlorocyclohexane.

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A STUDY ON THE METHODS OF ISOLATION AND CULTURE OF MYCO TUBERCULOSIS

CULTURAL tests prove unsatisfactory when sputa are concentrated with sodium hydroxide, antiformin and sulphuric acid. Not only are these digestants slightly toxic^{1,2} to the tubercle bacilli but they are not very effective decontaminants.

In our study of the isolation of tubercle bacilli from sputa prior to testing the tuberculostatic activity of antibiotics and other compounds we have tried various techniques of concentration to evaluate the best method for cultural purposes.

Toxicities of the commonly used digestants and those of trisodium phosphate³ and sulphonated castor oil (Turkey red oil) were investigated. The latter was used in the hope that the small clumps of bacilli might get dispersed and give a uniform luxuriant growth. The experiments were conducted firstly against a pure growth of tubercle bacilli and secondly against the tubercle bacilli in a homogenised sputum as the sputa might exert a slight protective effect on the bacilli.

The following tables give in brief the digestant used, the exposure time allowed, and the amount of growth in each tube. The tests were done in triplicate and the average assessed.

The above experiments indicate that Turkey red oil inhibits the growth of all types of organisms. Sulphuric acid is a powerful disinfectant but also slows or prevents the growth of tubercle bacilli after 24 hours contact. Trisodium phosphate proves the best of all, and is able to initiate the growth even after 3 days exposure.

TABLE I

Growth of Tubercle bacilli on petrik's media inoculated with 10⁻³ mg. of aqueous suspensions of Tubercle bacilli exposed to various digestants

Exposure time	NaOH 2%	Digestants (final concentration)			
		H ₂ SO ₄ 3%	Antiformin 25%	Trisodium phosphate 5%	Turkey red oil 1%
Control	+++	+++	+++	+++	+
½ hour	+++	++	+++	+++	0
2 hours	+	+	++	++	0
24 hours	+	0	+	++	0
48 hours	0	0	0	+	0

Control: Medium inoculated immediately after mixing bacillary suspension and neutralised digestant. +++ = Heavy growth, ++ = Medium growth, + = Slight growth, 0 = No growth.

TABLE II

Growth of Tubercle bacilli on petrik's media inoculated with homogenised sputum containing Tubercle bacilli exposed to various digestants

Exposure time	NaOH 2%	Digestants (final concentration)			
		H ₂ SO ₄ 3%	Antiformin 25%	Trisodium phosphate 25%	Turkey red oil 1%
15 mins.	Cont.	Cont.	Cont.	Cont.	0
30 "	+++	+++	+++	+++	0
2 hrs.	+++	++	++	+++	0
24 "	+	+	+	++	0
48 "	+	0	+	+	0
72 "	0	0	0	+	0

Cont - Contaminated.

Fuller details of the experiment will be published elsewhere.

My thanks are due to Dr. N. N. De and Dr. K. P. Menon for their valuable suggestions.

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**ANTIBACTERIAL PROPERTIES OF
SOME QUINOLINE SUBSTITUTED
GUANIDES WITH SPECIAL REFERENCE
TO THE ACUTE TOXICITY AND
THE BACTERIOSTATIC ACTIVITY OF
N'-(p-CHLOROPHENYL)-N⁵-(8' CHLORO-
5' QUINOLYL) BIGUANIDE ACETATE**

QUINOLINE compounds are known to be strong antiseptics (Donath, 1881). Various di-oxy-quinoline compounds have been investigated by Mancini (1932). Quinoline derivatives exert bacteriostatic action and some of iodated derivatives are effective amebicides.¹ Sulphamide² and acridine³ substituted biguanides have been shown to possess bacteriostatic effect against some gram positive organisms.

In the course of work on quinoline substituted biguanides as possible antimalarials a number of N'-(8'chloro-5'quinolyl)-N⁵-substituted biguanides had been synthesised.^{4,5}

The antimalarial properties of these compounds have been studied.* The present paper describes the antibacterial activity of some of the compounds. Limiting concentrations which just inhibit the growth of the organisms *in vitro* are given in Table I.

Compound No. 133 exhibits very high antibacterial activity as compared with other compounds. Further detailed investigations of this compound were undertaken.

The common gram positive pyogenic cocci, and gram negative bacilli of enteric and dysenteric group of organisms, all obtained from the Central Research Institute, Kasauli, were employed.

Serial dilutions of the drug were prepared in the medium which were later inoculated with 0.1 c.c. of a 18-hour broth culture. Culture controls and drug controls were included in each assay. After incubation for 48 hours,

TABLE I

Compound No.	Name	Minimum bacteriostatic concentration (48 hrs. incubation at 37° C.)			
		Staphylo	Strepto (pyogenes)	Bact. Coli.	Bact. Typhosum
133	N'-(p-chlorophenyl)-N ⁵ -(8'-Chloro-5'-quinolyl) biguanide acetate	1: 50,000	1: 50,000	1: 25,000	1: 50,000
134	N'-(p-methoxyphenyl)-N ⁵ -(8'-chloro 5' quinolyl) biguanide acetate	1: 1,000	1: 1,000	1: 1,000	<1: 1,000
136	N ⁵ -(8'-chloro 5'-quinolyl)-N ³ -isopropyl guanidine acetate	<1: 1,000	1: 1,000	<1: 1,000	1: 1,000

* These Compounds were synthesised by Prof. P. C. Guha and P. R. Gupta in the organic chemistry laboratories of the Indian Institute of Science, Bangalore 3.

TABLE II
Antibacterial spectrum of compound No. 133

Micro organism	Control	Dilutions					
		1: 5,000	1: 10,000	1: 20,000	1: 30,000	1: 50,000	1: 100,000
Staphylo aureus	++	-	-	-	-	-	+
Strepto pyogenes	++	-	-	-	-	-	+
Bact. typhosum	++	-	-	-	-	-	+
Sal. para typhosum A	++	-	-	-	-	-	±
Bact. flexnevi	++	-	-	-	-	-	±
Bact. shiga	++	-	-	-	-	±	+
Bact. Coli	++	-	-	-	+	+	+

Legend: ++ Heavy growth; + Moderate growth; ± Faint growth; - No growth.

TABLE III
Acute toxicity of compound No. 133 for Mice

Dose mg.	Route administration	Number of mice	Average weight of mice (g.)	Death of mice (days)							Mortality %
				1	2	3	4	5	6	7	
8	i.v.	3	20	3	..	..	..	..	..	..	100
6	"	2	20	2	..	..	..	..	..	..	100
4	"	9	20	6	1	..	..	..	..	..	77
3.8	"	4	20	2	..	..	..	..	..	..	50
3.6	"	5	20	2	..	..	..	..	..	..	40
3.4	"	3	20	0	..	..	..	..	..	..	0
3.2	"	5	20	0	..	..	..	..	..	..	0

TABLE IV
Determination of LD_{50}

Dose mg./100 g.	Observed mortality	Deduced mortality	LD_{50}
30	2/2	..	..
20	7/9	11/13	..
19	2/4	4/8	19 mgm./100 g. body weight
18	2/5	2/9	..
17	0/3	..	..

the concentration of bacterial cell in each culture was turbidometrically determined. Results of observation are given in Table II.

The acute toxicity of the drug for the mice was determined. Graded doses of the drug in physiological saline were administered intravenously to young white mice. LD_{50} dose of the drug for this experimental animal was determined by Behren's method.⁶ Tables III and IV present the experimental details.

Analysis of the above data shows that the maximum tolerated dose of the compound is 17 mg./100 gms. body weight and the minimal lethal dose is 19 mg./100 gms. body weight.

Unless precise information is available as to the influence of the drug on great many biological and biochemical processes, it is difficult to discuss the effects observed in living animals. Examination of the toxic data for mice, however, reveals that the maximum tolerated dose of the compound compares favourably with that of the other drugs at present employed in the chemotherapy of various intestinal infections. The low toxicity and the high chemotherapeutic index of the compound indicates the possibility of its chemotherapeutic employment.

Our thanks are due to Prof. P. C. Guha and P. R. Gupta for kindly supplying the compounds and to Dr. K. P. Menon for the helpful

suggestions during the course of the investigation.

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CHALKONES FROM QUINACETO- PHENONE MONOMETHYL ETHER

KOSTANECKI and co-workers¹ condensed mono-methyl- or ethyl-ether of quinacetophenone with methoxy or ethoxy-aldehydes in presence of alkali and obtained flavanones instead of the expected *o*-hydroxy chalkones, the ring formation having taken place under the experimental conditions. Since then it has been taken for granted that mono-methyl ether of quinacetophenone yields flavanones: while its isomer, resacetophenone methyl or ethyl ether² does give chalkones.

We have now exhaustively investigated the chalkone formation from quinacetophenone

mono-methyl ether. Repeating Kostanecki's experiments but without heating, we have been successful in isolating the chalkone from the reaction mixture after the removal of the flavanone. We have thus been successful in getting chalkones from anisaldehyde, veratraldehyde and o-methoxy-benzaldehyde. A method has been worked out for the separation of the above chalkone-flavanone mixture.

The chalkones obtained are orange to red coloured substances responding to Wilson's boric acid colour test³ as well as to magnesium and hydrochloric acid test.⁴

The details of these experiments will be published elsewhere.

The work on the chalkone formation from mono-ethyl ether of quinacetophenone is in progress.

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A NOTE ON THE INFLUENCE OF BORON ON THE YIELD AND ASCORBIC ACID CONTENT IN THE TOMATO FRUIT

THE indispensability of boron for more and better yield in plants has been proved by a number of workers.¹⁻⁴ But, little effort has been made to show precisely to what extent the element influences the yield and quality in higher concentrations.

It is evident by analyses (Table) that boron increases the yield of tomato fruit considerably in number and weight, with increasing doses of the element. The plants in complete absence of the element are severely set back in the size and yield of fruit as a large number of flower buds die before they could fully develop resulting in low yield.

It is clear from the table that ascorbic acid content gradually increased from green to yellow and red with increasing concentrations of the element, in general. However, the content of vitamin C was greater in fully ripened fruits in all cases, and the maximum in 3.0 p.p.m. A number of workers¹⁻⁴ have reported an increase in vitamin C in tomato grown in pre-

sence of boron than in absence of it. Although, it is clear from this investigation that ascorbic acid content is influenced by boron, the *Influence of boron on the yield and vitamin C content in the tomato fruit*

Treatments	Yield of fruits		Vitamin C content (in mgm. E. Q. per 100 c.c. of the juice) in different stages of the fruit		
	No. of fruits	Wt. in pounds	Green	Yellow	Red (Kipe)
No Boron	61	5.54	13.80	15.35	19.10
Boron 0.5 p.p.m.	95	8.68	17.70	19.04	20.30
„ 1.0 „	118	12.40	16.30	14.82	23.40
„ 2.0 „	123	15.27	21.00	27.25	33.60
„ 3.0 „	137	15.91	24.40	23.67	37.80

acid content, in general increased with increasing concentrations of boron, it cannot definitely be concluded to what extent the element influences the vitamin C content in tomato fruits as the vitamin C content is not merely influenced by the element, but also by the environmental conditions and the time of picking the fruit.

I am thankful to Prof. K. Kumar for his kind help during the course of this work.

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ANATOMICAL CHANGES IN THE EMBRYO OF MUSTARD DURING VERNALISATION

ANATOMICAL changes in relation to flowering in both normal and plants subjected to photoperiodic treatment have been thoroughly investigated by a number of workers,^{1,2} but, as far as the author is aware, there is hardly any observation on plants induced to flower early through low temperature treatment. There exists a fundamental difference between the two, as the photoperiodic induction takes place in plants with well developed foliar leaves while in vernalisation the changes are confined to the embryo^{3,4} where hardly any differentiation has taken place. This makes it necessary to follow the histological changes of the normal and chilled embryos and the subsequent behaviour of the seedlings and plants raised from them. In order to collect data on the same,

a series of investigations have been undertaken by the author on the various crops that have given vernalisation response under Indian conditions, and the present communication summarises the results obtained on the comparative vascular differentiation of the embryos of yellow sarson, T. 102, vernalised according to the technique of Sen and Chakravarti.⁹

In order to avoid error due to the difference in the size of the embryos to be compared, only unsplit seeds and split seeds with radicles just emerging out of the seed coat are selected. These are fixed in F.A.A., embedded in paraffin and sectioned serially at 13 μ and stained in iron-alum hæmatoxylin and safranin.

In the following table are given the vascu-

Treatment	Earliness in days	Vascular counts							
		Embryos							
		I		II		III		IV	
		Cot. I	Cot. II	Cot. I	Cot. II	Cot. I	Cot. II	Cot. I	Cot. II
Soaked for 6 hours ..	..	No Vascular differentiation							
Unsplit seeds chilled for 6 days ..	5.67	*2; 0	2; 0	0; 0	0; 0	2; 0	?; ?	1; 0	0; 0
Unsplit seeds chilled for 21 days ..	33.73	?; 7	?; 6	4; 7	3; 6	3; 7	5; 8	..	..
Just splitting untreated seeds ..	..	2; 0	?; ?	3; 0	4; 0	5; 0	?; ?	4; 2	?; 0
Just splitting seeds chilled for 21 days ..	39.29	4; 11	3; 10	6; 8	4; ?	5; 9	?; ?	..	..

* The first figure in each column indicates the number of mature phloem elements and the second that of xylem.

? Counts not possible due to obliqueness of the section.

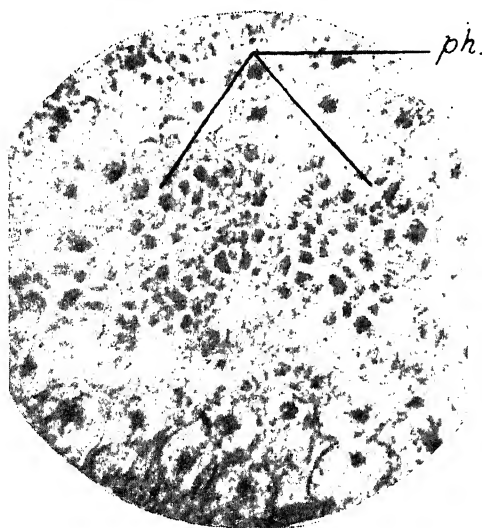


FIG. 1

FIG. 1. Transverse section of mid-vein of seedling III, Cot. I, of just splitting untreated seeds. Ph. Phloem elements. ($\times 440$).

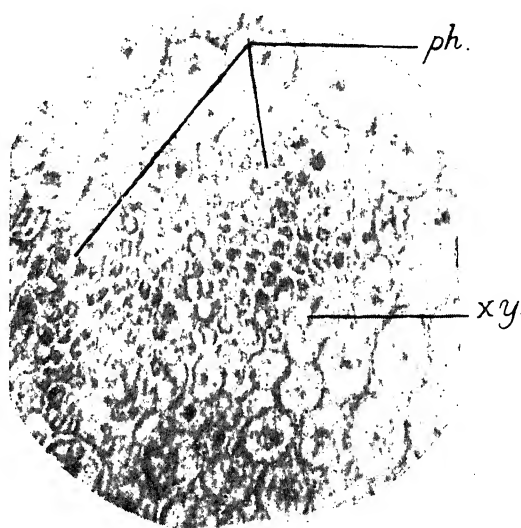


FIG. 2

FIG. 2. Transverse section of mid-vein of seedling III, Cot. I, of just splitting seeds chilled for 21 days. Xy. Xylem elements ($\times 440$).

lar counts in the mid-vein of the cotyledonary petiole near the stem-tip of three to four seedlings out of nearly a dozen examined per treatment. As the embryo of mustard is very much curved, counts in all the seedlings at the same height are not possible. The vernalisation response recorded is from October 12, 1949 sowing.

From the above table and Figs. 1 and 2, it would be clear that in the cotyledonary traces of mustard, the differentiation of xylem elements is preceded by that of the phloem, and the former is much more rapid in the treated than in the corresponding untreated. The cotyledonary petiole of the split seeds chilled for 21 days have as many as 8 to 11 xylary elements fully differentiated, while there is none in three and only 2 in one of the four corresponding untreated embryos. The number of xylary elements in unsplit seeds with 5.56 days longer vegetative cycle varied from 6 to 8, indicating thereby a positive correlation between their number and degree of vernalisation.

This differentiation in the untreated seeds is not only confined to the cotyledonary petiole but extends throughout the entire length from the tip of the radicle to the cotyledons. In the cotyledons of just sprouting untreated seeds, all the veins are in the procambium stage, while majority of those in the corresponding treated ones have xylem and phloem elements differentiated, the number of which varies according to the position of the veins.

Bassarskaja,⁵ working on rye, reports that there exists no structural difference between the treated and untreated seeds. This indicates that mustard differs from the cereal crops not only as regards its requirements during chilling^{4,6} and germination⁷ of the excised embryos, the behaviour on storage of the vernalised seeds,^{8,9} and non-obligatory low temperature requirement for the thermophase,⁹ but also as regards anatomical changes during the process of chilling.

The significance of this early vascular differentiation in vernalised seeds is not clear. The problem of transport which is practically nil at such an early stage, is identical in both the treated and the untreated seeds. However, it is definite that on sowing, the treated seedlings get an advantage over the untreated ones in having an elaborate transporting system which might help them in completing the vegetative cycle early.

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his kind help during the preparation of this note.

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A SIMPLE SAND CULTURE EQUIPMENT FOR GROWING RICE PLANTS

Two methods are described for growing rice plants in sand substratum—the drip method and the flush method.

In the drip method (Fig. 1) a glazed porcelain pot (A) of height 27 cm. and internal dia-

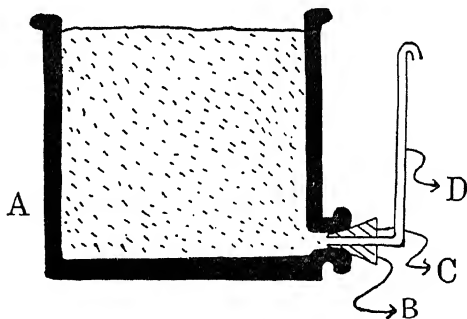


FIG. 1

meter 25 cm. with a drain hole on the side (B) was used as a culture jar and fitted with a one holed stopper (C) containing a bent glass tube (D). The pot contains coarse river sand, which had been first washed with 5 per cent. solution of HCl and subsequently with 5 per cent. solution of ammonium hydroxide and water.¹ Rice seedlings (D.I. 4 seeds, supplied by the Bidydharpur Government Farm) of 8-9 cm. height were transplanted to the sand substratum of the pot. The required nutrient solution was stored in a reservoir which was kept on a raised support. The solution was allowed to drip over the surface of the sand through glass pipes. The excess of the nutrient solu-

tion from the pot flowed away from the bent glass tube (Fig. 1 D). Thus, a continuous flow of the nutrient solution was maintained.

In the flush method (used in the micro-nutritional study of the effect of boron on the growth and development of the rice plant) the same glazed pots were used. The arrangement of apparatus is illustrated in Fig. 2. Inside the glazed pot (A) a layer of stonegravel (S')

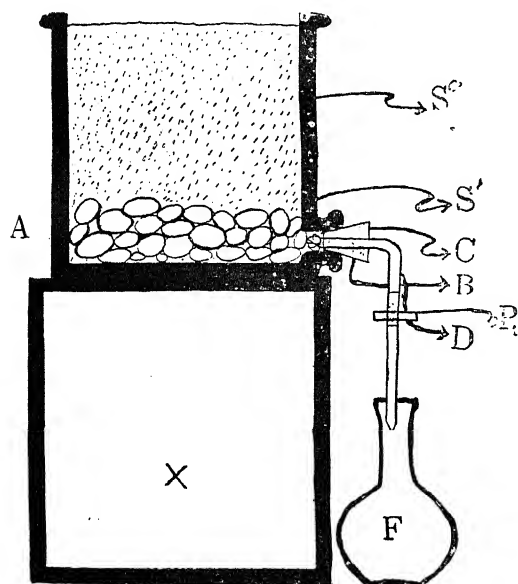


FIG. 2

(collected from the river bed and washed in HCl and subsequently in ammonia and water) was covered with washed sand (S''). The drain hole (B) of the pot was fitted with a one-holed cork (C) to which a bent glass tube (D) had been attached. One end of the glass tube (inside the pot) was plugged with glasswool to check the displacement of sand particles and to the other end, a rubber tubing with a pinch cock (P₁), which regulated the discharge of the culture solution, was fitted up. The pot was kept on a cement bench (X) and a large flask (F) was kept just below the tube to collect the discharged solution. The solution was allowed to drain out from the pot every evening and the collected solution was replaced the next morning. Each week the solution was discarded (twice or thrice) and fresh solution was added.

It was observed that in the case of pots where the solution was supplied continuously, there were thick crust formation on the surface of the sand, whereas no such crust formation was noticed in pots where the solution was

changed twice weekly. The crust formation was due to too much damping of the surface of the sand. It was also noted that the leaves of plants fed continuously with the culture solution were slightly pale looking but where the solution was changed biweekly, the plants were normal and healthy. The flush method also avoids the construction of a raised platform needed for the drip method. Pumping sets which have been used for sand culture work by a number of workers were also not required. The crust formation was avoided and lastly in this method, the used solution can easily be taken for analysis.

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8. STAINING BACTERIAL FLAGELLA

STAINING flagella is a rather difficult process. Different methods have been suggested from time to time, but no one method has been universally accepted because of lack of uniformly good results. In actual practice, the bacteriologists try many methods, but adopt one giving the best performance. Of the methods advocated by Gray,¹ Zettnow,² Van Ermengem,² Bailey,¹ Leifson,¹ Pitfield,² Loeffler,² and Cesares-Gil,¹ the last 3 have usually given us fairly good results. The following protocol has, however, given us surprisingly better results with several organisms.

(1) A loopful of 12-18 hr. old culture grown on potato dextrose agar slant is carefully placed in a drop of water on a clean slide gently touching and spreading it to 2 sq. cm. until faint turbidity is obtained. Dry in air.

(2) To cover the smear, add 4 drops of solution 'A' to be immediately followed by 4 drops of solution 'B'. Heat gently until fumes come out without boiling, the entire process taking 2 minutes.

(3) Add two drops of solution 'C' and heat the slide for 3 minutes until fumes come out without boiling. This important procedure of mordanting and staining should be followed carefully.

- (4) Wash in a gentle stream of water.
(5) Flood the smear again with solution 'C' and heat gently for 1½ to 2 minutes or until fumes come out without boiling.
(6) Wash in a gentle flow of water, dry in air or over a flame and examine.

SOLUTION 'A'		SOLUTION 'B'	
Tannic acid	.. 2 gm.	Iodine crystals	.. 2 gm.
Dist. water	.. 100 ml.	1 N. NaOH	.. 10 ml.
Filter and store		Make it upto 100 ml. with water after iodine is dissolved.	

SOLUTION 'C'

(i)		(ii)	
Basic fuchsin	0.3 gm.	Phenol	.. 5 gm.
Ethyl alcohol (95%)	10 ml.	Dist. water	.. 95 ml.
Mix the two solutions.			

Iodine and sodium hydroxide in solution 'B' used as a mordant in Gram stain stand out, probably due to their alkaline nature. Phenol in solution 'C' on the other hand, intensifies basic fuchsin, possibly due to its withdrawing water from the bacterial cells and forming metallic shiny precipitate. Of the methods referred to above, only those of Bailey, Fisher and Conn (Bailey's modification), Casares-Gil and Gray utilise Ziehl-Neelsen carbol fuchsin stain (authors' solution 'C'). Thus 'A' only forms an additional solution in the protocol, a very great advantage.

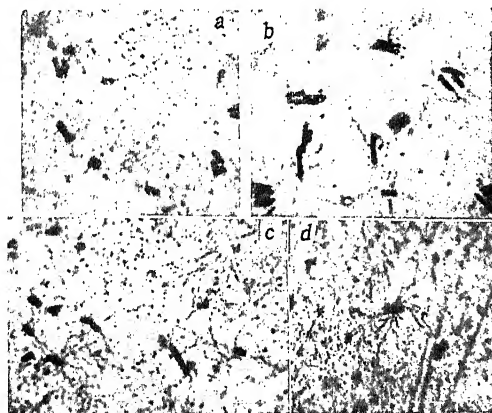


FIG. 1. Peritrichous flagella of, (a) *Bact. carotovorum*, (b) *B. subtilis*, (c) *Esch. Coli* and (d) *Rhizobium phaseoli* × 910.

The method advocated herein gives comparatively clean background, because of the finer and less conspicuous precipitates and lesser interference with the deep staining of bacterial cells and their flagella (Fig. 1) *Escherichia coli*,

Bacillus subtilis, *Bacterium carotovorum*, *Xanthomonas malvacearum*, *Pseudomonas aeruginosa*, *Ps. mangiferae-indicae* and two new spp. of plant pathogens, *Rhizobium phaseoli* and *Eberthella typhosa* have been successfully stained by this method.

College of Agriculture,
Poona,
April 24, 1950.

M. K. PATEL.
N. B. KULKARNI.
S. R. GAEKWAD.

1. *Manual of methods for pure culture study of bacteria*, Leaflet 4, by Society of American Bacteriologists, Geneva, New York, 1946. 2. Smith, E. F., *Bacteria in relation to plant diseases*, 1, Carnegie Inst., Washington, 1905.

MEIOSIS IN THREE GENERA OF INDIAN HETEROPTERA

Our knowledge of the chromosomes of Indian hemipterans is confined to a single paper by Misra² although much valuable work has been done on them in other countries (for reference see White³ and Hughes-Schrader¹). The present account deals with the meiosis of three species of Heteroptera belonging to as many genera and families.

Testes of adult males from the following material form the basis of the present study; (i) *Riptortus* sp., family Coreidae, (ii) *Spherodema rusticum* (Fabr.), family Belostomatidae; (iii) *Chrysocoris stolii* (Wolff.), family Pentatomidae. The material was collected from the suburbs of Calcutta. The testes were dissected out from the specimens in the living condition and fixed in Belling's modification of Navashin's mixture. Sections were cut at 20 to 25 μ thickness and stained in iodine-crystal violet. The figures are reproduced at a magnification of 3,000 diameters.

The chromosome numbers determined from the spermatogonial metaphase stages are $2n = 13, 12$ and 28 in *Riptortus*, *Chrysocoris* and *Spherodema* respectively (Figs. 1-3). Both *Riptortus* and *Spherodema* have a pair of minute chromosomes which stand out distinct in the mitotic complement whereas the smallest pair in *Chrysocoris* is not so easily distinguishable. Wilson⁴ termed the smallest pair of chromosomes in Coreidae as *m*-chromosomes. Reasonably accurate measurements of the chromosomes could be made only in *Riptortus* and *Chrysocoris*. Their sizes vary between $2.03-1.14 \mu$ in the former (except the *m*-chromosomes which are spherical having a diameter of $.33 \mu$) and between $1.03-0.55 \mu$ in the latter.

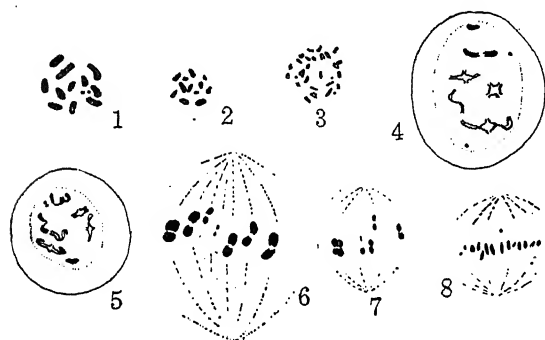
In the resting stage of the primary spermatocytes a spherical heterochromatic body is seen

in all the three species. *Chrysocoris* and *Spherodema* have an XX-XY and *Riptortus* XX-XO mechanism of sex determination (*vide infra*). It is likely that one of the sex chromosomes, probably the X, shows positive heteropycnotic behaviour at this stage. It is, however, possible that the X and Y fuse together to form a single mass in those species which have XY sex-determining mechanism. At diplotene, the bivalents, as a rule, form only one chiasma per bivalent which in some is interstitial and in others terminal. The chiasma frequency in *Riptortus* is one per bivalent

The single X chromosome in *Riptortus* passes towards one pole and can be easily identified because all the other chromosomes are bipartite, while it is single.

The author is indebted to Dr. S. P. Ray-Chaudhuri of the Calcutta University, for his help and guidance during the course of investigation and to Dr. A. P. Kapur of the Zoological Survey of India, for identification of the material.

Cytogenetics Laboratory, J. DAS GUPTA.
Zoology Department,
Calcutta University,
June 23, 1950.



FIGS. 1-3. Spermatogonial metaphase chromosomes in *Riptortus* sp., *Chrysocoris stollii* and *Spherodema rusticum* respectively. FIGS 4 & 5. Late diplotene stages in *Riptortus*. FIG. 6. Metaphase I in *Riptortus*. FIGS. 7 & 8. Metaphase II in *Chrysocoris* and *Spherodema* respectively. (Figs. 4 and 5) whereas it is slightly more than one in the other two species which indicates that only in a few cases there are two chiasmata per bivalent. The two members of the *m*-chromosome pair in *Riptortus* lie wide apart (Fig. 4) within the diplotene nuclei in 51 per cent. cases whereas in the rest they are closely apposed (Fig. 5) without forming any chiasma. The X chromosome in *Riptortus* is univalent and strongly heteropycnotic and the X and Y in the other two species are also heteropycnotic but lie distinct from each other. In diakinesis the *m*-chromosomes of *Riptortus* lie wide apart within the nuclei in 52 per cent. of cases.

In the first meiotic division, the sex chromosomes in all the three species divide but they segregate in the second division. It is to be noted, however, that the two *m*-chromosomes which were completely separate in about half of the diplotene and diakinesis nuclei in *Riptortus* are now invariably associated in pairs and pass regularly to the opposite poles of the spindle (Fig. 6). In the second division the X and Y in *Chrysocoris* and *Spherodema* form a pseudobivalent (Figs. 7 and 8) and pass to the opposite poles during anaphase separation.

1. Hughes-Schrader, S., *Advances in Genetics*, 1948, 2, Academic Press, New York.
2. Misra, A. B., *J. Fac. Sci. Hokkaido Univ.*, 1937, Ser. VI 5, 255-64.
3. White, M. J. D., *Animal Cytology and Evolution*, Oxford University Press, 1946.
4. Wilson, E. B., *J. Expt. Zool.*, 1905, 2, 507-45.

A MODIFIED TREATMENT AGAINST LOOSE SMUT OF WHEAT

WHEAT occupies an area of over one and a half million acres in Bombay State (excluding the merged areas) and is fairly well distributed. Loose smut [*Ustilago tritici* (Pers.) Rostr.] occurs to the extent of 5 to 10 per cent., the damage varying from year to year. Taking the average loss at 5 per cent., the total annual loss works out to 14,285 tons of grain or Rs. 40,00,000.

Luthra and Sattar¹ modified Jensen's hot water treatment by taking advantage of high temperatures of 120° and 130° F. in the shade and sun respectively during June-August at Lyallpur. The modified treatment could not be used in Bombay since the temperature in the sun hardly exceeds 121° F. Table I shows the temperatures recorded at Viramgam, Broach, Jalgaon, Bijapur and Poona during the first fortnight of May, the hottest month of the year.

TABLE I

Stations	Maximum temperatures			
	In open		In shade Air	
	Water	Air		
Viramgam	.. 111	121	110-111	
Broach	.. 105	116	104-107	
Jalgaon	.. 109	120	109-110	
Bijapur	.. 107	110	101-103	
Poona	.. 104	106	101-102	

It is seen that the temperatures at Viramgam, the hottest place in the Bombay State are

in every case lower by 9-10° F. than that at Lyallpur.

A modification of the solar energy method was devised at Broach during the first fortnight of May 1948, with successful results. It consisted of soaking the seed in water at room temperature from 8 a.m. to 12 noon, then spreading it in a thin layer on plain galvanised iron sheets in the sun for 1½ to 2 hours. Stirring the seed once or twice during this period keeps it in contact with the hot surface of the sheet. The temperature of seed collected in a heap at the end of the exposure was found to be 130-133° F. This had two advantages over the method of Vasudeva and Iyengar,² viz., (1) brick-floor is not necessary, and (2) it can be employed in Peninsular India where temperatures are not as high as in Northern India.

The seed was dried thoroughly under shade, mixed with B.H.C. to avoid insect attack and stored. The treatment had no adverse effect on germination. The treated seed was dibbled in 4 replications at Pakhajan (Broach District), Jalgaon, Dharwar and Poona during two years (1948-49, 1949-50). The results are given below:—

TABLE II
Effect of solar heat exposure on the
per cent. infection by loose smut

Treatment (Period of exposure on sheet)	Per cent. infection at			
	Broach*	Jalgaon*	Dharwar*	Poona†
1 hour	0.0	0.03	0.09	0.13
1½ hours	0.0	0.00	0.00	0.00
2 "	0.0	0.00	0.00	0.00
Control	6.2	4.7	3.6	4.1

* Based on the initial population of 3,000 plants and
† 800 plants in each treatment.

The results indicate that exposing soaked seed on galvanised iron sheet to the sun for 1½ to 2 hours completely controls the disease.

Thanks are due to Shri. B. J. Thakar, Cotton Breeder, Broach, for providing facilities during these investigations.

Plant Path. Lab.,
Agricultural College,
Poona,
August 3, 1950.

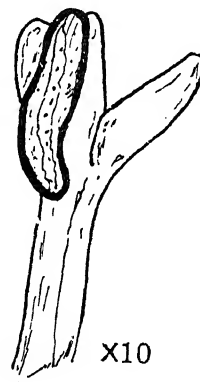
M. K. PATEL.
G. W. DHANDE.
Y. S. KULKARNI.

1. Luthra, J. C. and Sattar, A., *Ind. J. Agric. Sci.*, 1934, 4, 177. 2. Vasudeva, R. S. and Iyengar, M. R. S., *Curr. Sci.*, 1950, 19, 218.

A NOTE ON THE TERATOLOGY OF FLOWERS OF *ZEPHRANTHES* *ROSEUM* LINDL.

IN August 1948, the writer observed some teratological characters in the flowers of *Zephranthes roseum* Lindl., family Amaryllidaceæ, cultivated in the Botanical Garden, Khalsa College, Amritsar. However, in the flowers of the plants growing on the Mussoorie hills none of such abnormalities were observed.

The flowers showed a hexa-merous tendency, partial staminody of the petals and partial petalody of the stamens and an increase in the bifurcation of the stigmas into as many parts as the loculi in the ovary—from trilocular to hexalocular. An interesting feature noted in a flower was that an anther lobe had developed on one of the arms of the stigma. The anther lacked a filament, but possessed normal pollen grains (Fig. 1).



The development of an anther on the stigma has not been reported so far to the author's knowledge.

Botany Department,
University, Gauhati,
July 23, 1950.

P. KACHROO.

CINTRACTIA MINOR ON THREE SPECIES OF *CYPERUS* IN MYSORE

COLLECTIONS of smuts were made on three species of *Cyperus* near Hebbal, Bangalore. On *Cyperus rotundus* L., *C. compressus* L., and *C. pringorei* Rottb., the infection occurred both on the peduncles and within the ovary. In the latter case, the hard seed was replaced by an agglutinated black spore mass. Comparative studies indicated that a single species was involved on all the three hosts, and the smut was identical with *Cintractia minor* (Clinton) Jackson,¹ which is already known to parasitise the ovaries and peduncles of *Cyperus* sp. The

sori were at first covered by the false membrane, which flakes away at maturity exposing the olive-black agglutinated spore mass. The spores were reddish-brown, subglobose to spherical, and measured 9 to 12.5 μ in diameter with a mean of 11 μ .

Review of literature indicated that *Cintractia minor* has been incorrectly cited in India as *C. peribebuyensis* (Speg.) Speg. including in a recent paper by Venkatarayan,⁴ though Ling² by a study of the type material pointed out that *C. peribebuyensis* is synonymous with *C. axicola* (Berk.) Cornu. *C. minor* proposed by Jackson¹ by raising *C. axicola* var. *minor* Clinton. to specific rank is a separate smut species. For *C. minor* on *Cyperus Pangorei*, Venkatarayan⁴ gives an expatiated account of the sori development, which, in general, conforms to the earlier descriptions given by McAlpine³ and others for *Cintractia*.

Bangalore,

K. M. SAFEEULLA.

August 25, 1950.

H. C. GOVINDU.

1. Jackson, H. S., *Mycologia*, 1920, 12, 153.
2. Ling Lee, *Revista Argent. de Agronomia*, 1948, 15, 254-55.
3. McAlpine, D., *The Smuts of Australia*, 1910, p. 288.
4. Venkatarayan, S. V., *Curr. Sci.*, 1949, 18, 13.

A CASE OF TWIN OVULES IN *ISOMERIS ARBOREA*

DURING the course of a reinvestigation of the embryology of *Isomeris arborea* (Capparidaceæ), undertaken at the suggestion of Dr. P. Maheshwari, a case of abnormal twinning of ovules has been observed.

The ovule of *Isomeris arborea* is campylotropous, bitegmic and crassinucellate. The micro-pyle is formed by both the integuments. The abnormal case of twin ovules consisted of two ovules borne on the same funicle and enclosed within a single, common outer integument, the nucellus of each ovule being surrounded by its own separate inner integument (Fig. 1). The ovules borne on the same funicle and enclosed As shown in the figure, one of the ovules was seen in longitudinal section, the other being cut transversely and showing a circular outline. This indicates that the two ovules were situated at right angles to each other.

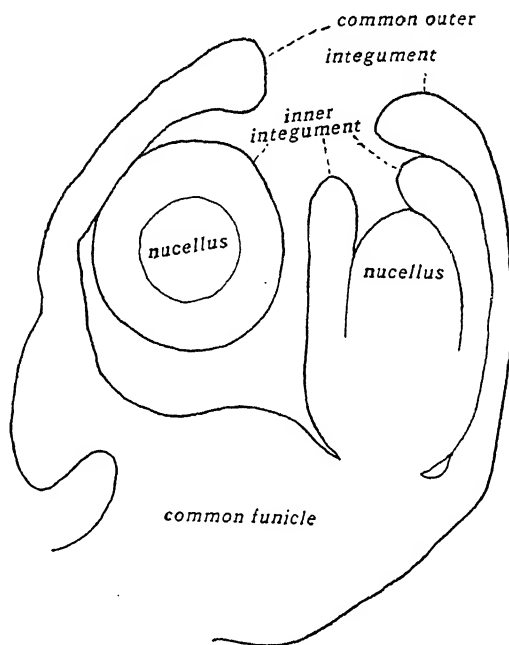


FIG. 1. *Isomeris arborea*. An outline drawing of the twin ovules. $\times 332$.

A case somewhat similar to the one described here has been reported by Rao¹ (1938) in *Capparis galeata* in which "two completely separate nucelli are enclosed by the same integument". This case is also peculiar because it seems that there is only one integument here as shown by his figure as well. The two nucelli seem to be situated side by side in the same plane and not at right angles to each other as in the present case.

The material on which this note is based was collected by Prof. P. Maheshwari in California in 1947 and later passed on to me for reinvestigation. I gratefully acknowledge the help received from him in connection with this work.

Botany Department,
Aligarh Muslim University,
Aligarh, U.P.,
August 10, 1950.

REAYAT KHAN.

1. Rao, V. S., "Studies on Capparidaceæ-III. Genus *Capparis*," *J. Indian Bot. Soc.*, 1938, 17, 69-80.

REVIEWS

Fourier Methods. By Philip Franklin. (McGraw Hill Book Co., New York), 1949. Price \$4.00.

This text-book is intended as an introduction to Fourier Series and Laplace Transformation and their application to the solution of some of the boundary value problems in Physics and Engineering. The aim of the author appears to be to impart to the student facility in the technique of applying Fourier Series and Laplace Transforms to actual boundary value problems. Thus we find that, while the formal processes of calculating the Fourier coefficients and the solution of particular boundary value problems is illustrated at some length by means of a variety of examples carefully worked out, the relevant theorems of convergence, etc., are only stated without proof. The problems treated are those of heat conduction, the vibrating string, the transmission line and the hollow rectangular wave-guide. The last chapter contains a short and lucid introduction to the method of the Laplace Transformation for the solution of boundary value problems, along with a brief table of Laplace Transforms. Each chapter contains a large collection of carefully chosen exercises, and references to sources of further information. The book may be heartily recommended to those who wish to acquire quickly some familiarity with these standard methods for the solution of boundary value problems.

V. R. T.

Progressive Mathematics. By P. Clyme, Responsible Lecturer in Engineering Department at Mid.-Essex Technical College, Chelmsford. (Chapman & Hall Ltd., London), 1950. Pp. 270. Price 15 sh. net.

This book is intended mainly for Higher National certificate candidates for Physics and Engineering, though, as the author writes in its preface, the volume does not purport to cover any particular syllabus. The topics covered include the usual portions of Algebra, Trigonometry, Analytical Geometry, Calculus with its applications to Geometry and Mechanics, Fourier's series and Harmonic Analysis. The book concludes with a chapter on Differential Equations and a few appendices.

The author adopts an entirely new approach to mathematical teaching, which departs from all traditional methods. One of the features of that approach is the introduction of occasional

dialogues between student and teacher. But, in the opinion of the reviewer, the unconventionality of the exposition has been rather overdone. In introducing basic mathematical concepts like limit, the sum of an infinite series and so on, the author ought to have exercised some restraint even while catering to the 'difficult ones' amongst his students. His treatment of indeterminate quantities and infinite series does hardly any justice to 'progressive' mathematics! Some of his unconventional ways of expression may be quoted as samples: $\frac{1}{0} \rightarrow \infty$, " $\frac{0}{0}$ may be anything from 0 to ∞ " (why not, if it comes to that, from $-\infty$ to $+\infty$?). "An infinite series is said to be convergent or divergent according as to whether its sum is finite or not" (whatever the word 'sum' means!). "If the terms of a series are alternately positive and negative and the numerical value of each term is less than that of the preceeding term, the series is convergent." And so on. The book abounds in such statements. From the standpoint of mathematical teaching, one wonders as to how far the book is of true service to the students for whom it is written.

T. S. N.

Mechanics *via* the Calculus. By P. W. Norris and W. Seymour Legge. Third Edition, enlarged. (Clever Hume Press, Ltd., London), 1950. Pp. xii + 367. Price 16 sh.

This is a new edition of a work which has been popular, particularly with students of engineering, and its issue shows that the demand for the book is continuing. It is distinguished especially by the large number of typical problems worked out in detail and equally by the numerous exercises, some 550 in number. The principles of the subject are enunciated with a view to provide the basis for the problems, rather than for their intrinsic interest. This edition is mainly a reprint of the first edition, even a misprint on p. 224 remaining uncorrected. But some problems have been added wherever there was space remaining in a page at the end of a chapter, while a new chapter on Vectors and Vector Algebra and two appendices—one on the Principal Axes of Inertia, and the other on the Instantaneous Centre of Rotation—have been added. The notation for a vector product is not the usual one of Gibbs— $\mathbf{a} \wedge \mathbf{b}$ instead of $\mathbf{a} \times \mathbf{b}$. Triple products

and differentiation of a vector with respect to a scalar are included, but not the operator ∇ . The chapter gives a taste of vector methods which may lead the interested student to further study. We wish the book a continued life of service.

T. S. S.

G. N. RAMACHANDRAN.

Verstandliche Elemente der Wellenmechanik: I Teil, Photonen, freie Elektronen, einelektronige Atome (Intelligible elements of wavemechanics: Part I, Photons, free electrons and one electron atoms). By Karl Jellinek. (Wepf & Co., Verlag, Basel), 1950. Pp. 304. Price Sw. Fr. 34.

In spite of the fact that a number of textbooks and treatises are already available dealing with wave mechanics, the book under review is a welcome addition to the literature on the subject. It is essentially addressed to the experimental physicists and chemists, who are interested in the application of wave mechanical ideas in interpreting their results and who wish to familiarise themselves with the basic concepts of the new mechanics. In fact, the sub-title of the book is "Eine Einführung für experimentelle Naturwissenschaftler".

Prof. Jellinek is the well-known author of the five-volume *Lehrbuch der physikalischen Chemie*. In his *Lehrbuch*, many topics were discussed from the standpoint of wave mechanics, although no presentation was given of the fundamentals of the subject. The present volume is the outcome of Prof. Jellinek's attempt to fill up this deficiency. It is the first of two volumes, the second of which will deal with atoms having more than one electron and with di- and polyatomic molecules. The following list of chapter headings will give an idea of the scope of the present book: I. Wave mechanics and light, II. Wave mechanics and matter, III. Differential equations, IV. The partial differential equation of wave propagation, V. Standing waves, VI. The time-independent Schrodinger equation, VII. Particle in a cavity with impenetrable walls, VIII. The linear harmonic oscillator, IX. The spatial harmonic oscillator, X. The rigid rotator, XI. The hydrogen atom, XII. Potential barriers. Although it would appear from the above that the book is mainly mathematical, the emphasis is essentially on physical concepts rather than on mathematical formalism. In fact, only a knowledge of the calculus is expected on the part of the reader and any other mathematics that is required is developed in the course of the book itself.

The reviewer regrets that this book was not written in English although the author is resid-

ing at present in London, as is noted from the preface. However, the treatment is so lucid that persons even with a small acquaintance of the German language can profitably read through the book. It should find a place in every chemist's library.

Hyderabad Engineering Research Laboratories: Annual Report for 1949: Publication No 3. Pp. xxii + 260. Price Rs. 7-8-0.

The Report is divided into five parts, viz., Hydraulics, Soil mechanics, Engineering materials, Physics and Chemistry and Hydro-meteorology.

In the Hydraulics Section, reports about the tests conducted in connection with the design of suitable irrigation structures for the various projects in the Hyderabad State are given. Reports about experiments conducted, (1) to devise suitable divide walls at the junctions of aprons to arrest parallel flow and to provide subsidiary weirs below the protective works to eliminate shooting flow; (2) to design high coefficient weir profiles for free and submerged flows and stilling basin type energy dissipators with staggered blocks; (3) to design a spur and protective works to deflect a high velocity jet, etc., are given. Tests of a similar nature have been conducted by other research laboratories in India and elsewhere, and it would be an advantage if the results are pooled together to eliminate repetition as far as possible, though each case has its own peculiarities.

In the Soil Mechanics Section, the results of mechanical analysis of soil samples used for the manufacture of soil cement bricks, as well as a description of classification tests on certain soils and tests conducted on rammed earth are given. Results of various tests conducted to test the suitability of a particular soil for earth dam construction are also given. However, no mention is made about tests conducted to determine the shear strength of the soil.

In the section on engineering materials, various experiments conducted on the properties and strength of materials such as: the suitability of sand for use in surki mortar, cement concrete, etc.; the suitability of lime surki mortar for the Tungabhadra dam; the properties of aggregates in concrete, cement concrete of lean proportions; the thermal characteristic of corrugated iron, asbestos cement roofs and their insulation with paddy husk, mix, etc., are given.

In the section on physics and chemistry, results of tests conducted for chemical examina-

tion of the suitability of soils for earth dams, rammed earth walls, soil stabilisation analysis of lime, limestone, cement, etc., are given.

In the Hydro-Meteorology Section, results of preliminary investigation on evaporation losses from free water surfaces and study of evaporation losses on temperature basis are given.

V. K.

Technique of Radio Design. By E. E. Zepler. Second Edition, revised. (Chapman & Hall, London), 1949. Pp. xv + 394. Price 25 sh. net.

This is the second edition of a book, which was reviewed in detail, in a previous issue of *Current Science*.^{*} In this new edition, the book is very much improved and the author has taken pains to utilise the helpful suggestions made by critics. Such of the new material as was of practical importance has been added, but the general treatment remains the same. A welcome feature of the book is the chapter on receiver noise and the twenty-two pages devoted to it are most useful and well-balanced. In fact, it is an achievement on the part of the author to sift the vast volume of material now available and compress it in such a short space.

The book is larger in size by 94 pages and 23 new diagrams have been added. The printing and get-up continues to be good. This new edition can be most heartily recommended to students of communication engineering and to libraries.

S. V. CHANDRASHEKHAR AIYA.

^{*} *Curr. Sci.*, 1943, 12, p 260.

An Introduction to the Theory and Design of Electric Wave Filters. By F. Scowen. Second Edition, revised. (Published by Chapman & Hall, London), 1950. Pp. xi + 188. Price 18 sh. net.

This book written by a person actively engaged in the design of filters, is indispensable to every worker in the field. It is divided into twenty chapters dealing with the mathematics required, general electrical theory, theory of filters, detailed consideration of low pass, high pass, band pass and band suppression types, etc. This is followed by detailed treatment of filter design, including the practical aspects. The last chapter is on Darlington's insertion loss method of filter design. This is an addition in the new edition. The division of the material into different chapters is very apt and each chapter contains the major information wanted.

The printing and get-up of the book are quite good and free from serious errors or misprints.

The book can be heartily recommended to every person interested in this field including the research workers, who will find the very brief but well-selected bibliography quite helpful.

S. V. CHANDRASHEKHAR AIYA.

Elsevier's Encyclopaedia of Organic Chemistry. Edited by F. Radt. Series III. Carboisocyclic condensed compounds. Vol. 12-B. Naphthalene. A. Compounds containing one naphthalene nucleus. Hydroxy compounds. (Elsevier Publishing Co., Inc., New York & Cleaver Hume Press, Ltd., London W. 1.), 1950. Pp. 1053-2187. Price £29-0-0.

Elsevier's *Encyclopædia*, undertaken as an English analogue of Beilstein, has already proved to be invaluable to organic chemists. In some ways Elsevier is superior to Beilstein, although the reputation of Beilstein for its comprehensive and dependable character is so great and well deserved that the relative merits of Elsevier can only be judged after a few years of use by many organic chemists interested in organic compounds of varied types. Elsevier has the advantage of being much more up to date; supplementary volumes of Beilstein do not cover the literature after 1920-27, and in view of the pace of progress in organic chemistry during 1920-50, the importance of an *Encyclopædia* which covers the literature up to (and in later volumes beyond) 1942 is obvious. In the present volume the literature till the end of 1944 has been consulted and, so far as the structure of compounds is concerned, the literature survey actually extends into the beginning of 1950. Each volume has a subject index and a formula index, the latter being particularly useful because the decennial indices of chemical abstracts do not include formula indices. The paper, printing and binding are superb; structural formulæ are set up very clearly. The arrangement of the subject-matter is excellent; with the aid of the subject and formula indices a compound can be located very readily. The description of each group of compounds begins with a useful summary. The data on the more important compounds includes physiological properties, methods of identification and analysis, and applications in analytical chemistry. To cite only one example of the scope of the information which is provided by Elsevier, the preparation and properties of β -naphthol (exclusive of its derivatives) are described in 40 pages which constitute a remarkably complete monograph on the substance.

Of the 18 volumes (plus Vol. XIX: subject index and Vol. XX: formula index) which are

to comprise Elsevier's *Encyclopædia*, Vols. XIV and XIII, Vol. XII-A and Vol. XII-B, Parts 1 and 2, have so far appeared. The book under review is the third part of XII-B, dealing with the hydroxy derivatives of naphthalene containing one or more hydroxyl groups in the nucleus or the side chain. The naphthoquinones and their derivatives, hydroxynaphthoic acids and naphtholsulphonic acids are not included in the part under review, except for incidental references as in the sulphonation of the naphthols, and further parts of Vol. XII-B will be awaited with interest. Organic compounds in patent literature are to be dealt with in additional volumes, but the logic of this procedure is difficult to see. Because of the greater labour involved in classifying the organic compounds described or mentioned in the patents of various countries, it was probably necessary to postpone this task in order to ensure that the publication of successive volumes of the *Encyclopædia*, already behind schedule, is not unduly delayed; but for the chemist who wishes to know if a compound is new and to have the fullest information on known compounds, the availability of all the data on a given compound and its derivatives in a single place would be a considerable simplification of his work.

Elsevier's Encyclopædia represents a service of the utmost importance to international progress in organic chemistry, and it is to be hoped that a way will be found for amalgamating further volumes of Beilstein and Elsevier.

K. V.

1948 Annual Report of the Nutrition Research Department of Health, O.S.R., Djakarta, Indonesia.

The Report deals with the activities of the Nutrition Research Institute for the year 1948. The fact that the directorship of the Institute

changed hands twice during the year is symptomatic of the effects which the disturbed post-war political conditions had even on the working of scientific institutes in Indonesia.

The Report is of particular interest to countries of the South East Asian Region. The conditions in most of these countries are similar economically and, to a certain extent, politically as well. Nutritional problems faced by them are also of the same pattern as was clearly shown at the Far Eastern Nutrition Committee meeting held under the auspices of the F.A.O. at Baguio in 1948 and in Rangoon in 1950. It is, therefore, worthwhile making a note of the difficulties which National Nutritional Institutes may have to meet in undertaking and pushing through programmes of nutritional studies for development. Most of the latter are handicapped at the start by lack of (a) trained personnel, (b) adequate funds and (c) desire on the part of the Governments concerned to consider health based on proper nutrition as a prerequisite for national development.

The Nutrition Research Institute of Indonesia is happily placed on account of its association with the Eijkmann Institute of international fame. In several other countries, no nutritional institutes exist and where they have recently been started they still continue to suffer from the effects of the disturbed economic and political conditions after World War II to be able to play an effective role in the fight against malnutrition. Nevertheless the Report under discussion gives hope that one may expect the near future fulfilment of the projects undertaken in Indonesia and that the work of this and other infant institutes in South East Asia will act as an incentive for other countries of the region to take steps in the same direction.

V. N. PATWARDHAN

OBITUARY

RAO SAHEB T. P. BHASKARA SASTRY

RAO SAHEB T. P. BHASKARA SASTRY, a pioneer of modern Indian Astronomy and formerly Director of Nizamiah Observatory, Begumpet, died on 26th June, 1950, at the age of sixty-one.

Sri. Bhaskara Sastry was born on 12th April 1889, at Thiruvadamaruthur in the Madras Presidency. Soon after his graduation from the Madras University in 1912, he joined the Nizamiah Observatory, Begumpet, as an Assistant and became its Director in 1922 and continued as Director till his retirement in 1944.

Under his care and guidance, the Observatory

completed the Carte-du-Ciel programme of photographing certain zones of the sky allocated to it by the International Astronomical Union. His work in this connection was recognised by the astronomical world and he was co-opted as a Member of the Carte-du-Ciel Commission of the International Astronomical Union. Besides astronomy, he was also interested in seismology and meteorology.

He was a Fellow of the Royal Astronomical Society, the Indian Academy of Sciences and the National Institute of Sciences of India.

A.

SCIENCE NOTES AND NEWS

Cosmic Ray Research on the Swiss Alps

Four Manchester University cosmic ray scientists are to winter at a research station on Jungfraujoch in the Swiss Alps to continue their research into the properties of "Taumensons". These are showers of newly discovered and very penetrating particles produced when the atom is broken by cosmic rays.

The Jungfraujoch experiments are a continuation of the cosmic ray research which has been carried out by Manchester University since before the war. The party's equipment will include a 14-ton magnet and apparatus to photograph the tracks of nuclear particles.

Mr. J. A. Newth will lead the team, which is expected to arrive at Murren (Switzerland) in October and commence its researches about the end of November. It will work under the direction of Prof. P. M. S. Blackett.

A party from Bristol University under Prof. C. F. Powell will photograph radio-active particles by a new method.

Common Names for Pest Control Products

The British Standards Institution now announces that the Technical Committee appointed to devise simple, common names for well-established pest control products (including insecticides, insect repellents, acaricides, nematocides, fungicides, herbicides and rodenticides) has prepared the first list, containing some 25 common names for the better-known products now in general use in agriculture and in veterinary circles throughout the country. This list is being circulated for technical comment among Government departments, manufacturers and the interested scientific societies before final publication. In order to pre-empt the use of these names as proprietary names, the list has been lodged with, and approved by H. M. Patent Office. The names will be given protection and will be referred to when application is made for the registration of proprietary names for pest control products.

Wherever possible, the names adopted conform with those already accepted as coined common names by the U.S. Department of Agriculture, and the same system of protection is given by the U.S. Patent Office. It is hoped that the same measures will extend to other countries in due course.

Raised Price Limit for Purchases of Scientific Material

The price limit for purchases of scientific material with UNESCO coupons, which was originally set at \$500, has now, as a result of the meeting held in Florence on 13th June, been raised to \$1,000.

Geological, Mining and Metallurgical Society of India

Officers and Members of the Council for 1950-51:—*President*: Dr. W. D. West; *Vice-Presidents*: Mr. M. K. Ray, Mr. B. P. Agarwala; *Joint Secretaries*: Prof. N. N. Chatterjee, Prof. N. L. Sharma; *Treasurer*: Prof. P. C. Datta; *Librarian*: Mr. Arun Kumar Roy; *Other Members of the Council*: Mr. S. K. Barooah, Mr. D. K. Chakravarty, Dr. M. Chatterjee, Mr. N. K. N. Iyengar, Mr. V. G. Iyer, Dr. C. Mahadevan, Mr. L. Rama Rao and Mr. Y. Nagappa.

Research Degree Award

On the recommendation of the Board of Examiners appointed to adjudicate on the thesis entitled, "Investigations on the Raman Effect", the Syndicate of the Madras University have declared Mr. P. K. Narayanaswamy, M.Sc., a student of the Physics Department of the Indian Institute of Science, qualified for the degree of Doctor of Philosophy.

National Campaign Against Malaria

A large-scale campaign to combat the ravages of malaria in India, where new cases are estimated at 2,400,000 yearly, has been started by the Government in co-operation with the World Health Organization (W.H.O.) and the United Nations Children's Emergency Fund. Teams of foreign experts are already working in the States of Uttar Pradesh, Mysore, Madras and Orissa. W.H.O. is providing technical personnel and advice, and the U.N. fund is furnishing equipment for the campaign.

Measures being taken include the treatment of malaria sufferers, examination of children, spraying of houses with DDT, and efforts to prevent the breeding of mosquitoes by filling or draining ditches. The Indian Government also aims to develop the pharmaceutical industry and to provide the quinine needed for the treatment of malaria victims.—(UNESCO.)

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THE CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE

FIFTH in India's chain of eleven National Laboratories, planned by the Council of Scientific and Industrial Research, the Central Food Technological Research Institute was formally declared open on October 21st last by the Hon'ble Mr. C. Rajagopalachari. This Institute would deal with "all problems which require close and high-level scientific research" in the food field. It owes its genesis to the recommendation in 1945 of the Industrial Research Planning Committee of the Council of Scientific and Industrial Research that the highest priority should be given to the development of food technology. This recommendation was endorsed by the various food industries' panels set up by the Government of India and it was agreed that the Institute should be started under the auspices of the Council of Scientific and Industrial Research. The proposal was accepted in principle by the Governing Body of the Council in February 1948 and a beginning was made possible to put into effect the detailed plans that were soon worked out by the offer of the Mysore Government to place the Cheluvamba Mansions, Mysore, together with the attached

buildings, gardens, parks and grounds, covering an area of 150 acres, at the disposal of the Council for the location of the Institute. The Hon'ble the Prime Minister, as President of the Council, received the Mansions formally from the Mysore Government in December 1948 and the first laboratories started functioning by the end of July 1949 with other additions following steadily. Early in 1950, the Government of India rightly decided to merge the Institute of Fruit Technology with this Institute.

The various Divisions of activity of the Institute include: storage and preservation, processing, engineering, biochemistry and nutrition, information and statistics, quality control, and microbiology and sanitation; a Division of dietetics and a Section for food containers are also being organised. It would seem best to have a few of the more important Divisions working in full strength right from the commencement and expand the activities of the Institute as progress is made and as exigencies may demand.

There is undoubtedly great scope for development and research in food technology by way of improvement in methods of storage,

study of microbiological and biochemical changes attendant on various types of spoilage, reclamation and utilisation of infested or otherwise affected food materials, processing of foodstuffs with a view to improving their keeping and nutritional qualities, refrigeration, freezing, gas storage, dehydration, canning, and so forth. Much of the more elaborate procedures of preservation employed in foreign countries needs to be simplified to suit the needs of the country and especially during the current evolutionary phase of our economy. There is also much that could be accomplished by way of collaboration with Agricultural Departments and Nutrition Research Centres in the country. Indeed, the establishment of regional laboratories working in close association with the central laboratories and dealing in particular with local problems should soon be envisaged. In addition, the pursuit of knowledge for its own sake would, it is hoped, form a substantial part of the activities of the Institute; its scientific reputation will, in fact, be determined by the quality and output of the fundamental work done by it. Mr. Rajagopalachari stressed on this fact that much of the future of the Institute will admittedly depend on the quality of the men that will hold charge of its various activities and on their keenness in applying themselves as a team to the problems they will handle. "You should deal with trained men as you deal with other tools of work. There should be no favouritism in selecting a chisel or a razor. You should respect quality and aptitude and get along without favour or compromise."

In referring to some of the findings of the Institute like the so-called "synthetic rices" and "substitute milks", the Rajpramukh, the Maharaja of Mysore, who presided on the occasion, rightly observed that when substitutes for rice or for milk or for any other food are found, people at large are apt to be averse in utilising such products and that therefore it was incumbent on educated people "to expel such reluctance by betaking to such products themselves first and that openly. Conduct spreads by conduct and leadership in thought should be sustained by leadership in action, for social conduct flows like the purifying and fertilising Ganges from the heights to the plains below. The educated classes had thus an imperative obligation to see that their ways of life were conceived and directed by social objectives and values".

In a message for the occasion, Prime Minister Jawaharlal Nehru said that the National Laboratories in the country would be "the

homes of productive effort and work. It is ultimately on the basis of the work done in the research institutes and laboratories that we can progress in most directions. Thus far, we have depended on other countries and have merely copied them or taken advantage of something that they have done. We cannot go far with this dependence. We have at least laid good and true foundations for scientific progress. It is for the young scientists of India to take advantage of the great opportunities offered to them and thus help in building up the New India". He expressed the hope that "the work done in this Institute will bear fruit not in developments on paper and in scientific journals alone, but in terms of human values and in increase of suitable food for our people". Dr. Shanti Swarup Bhatnagar who has rightly earned a great name for his formidable drive and organising capacity and who has been the chief instrument in the rapid establishment of the different National Laboratories, expressed his confidence that *within a year's time* the Institute will make a "distinct contribution towards the solution of food shortage in India by its technological research". These hopes and assurances that have been voiced at this inauguration auger well for the future of this important Institution.

It may perhaps be contended that the inception and functional activities, under Government aegis, of the various National Laboratories would have a weaning effect on the other established research centres and University Laboratories, especially as recruitment to the senior posts of these national institutions has been mostly from these latter sources. Together with the necessary preparatory period before the National Laboratories can blossom into full activity, this circumstance, it may be viewed, might result in a temporary decrease in the scientific output of the country. Such an interpretation is probably baseless and, provided sufficient encouragement and funds are forthcoming, Universities should be able to hold their own in their different fields of research. Paying a tribute to the valuable work done by men of science in the country before the National Laboratories were conceived, Mr. Rajagopalachari observed: "This work was done under great difficulties and without the assistance of big laboratories such as we have now installed. In the Universities as well as in Scientific Academies outside Universities, very eminent sons of India have brought credit to our Motherland by their work. In modern days, however, scientific research has become highly organised,

The individual becomes a member of a team and his sphere of work is intensive though possibly restricted to a small subdivision of a section of the science in which he works. It is in this respect that we should congratulate our-

selves on the opening of the National Laboratories and Research Institutes during the last three years such as the one we have assembled to bless to-day".

NOBEL AWARD FOR PHYSICS

THE Nobel Prize for Physics for the year 1950 has been awarded to the British Nuclear Physicist, Prof. Cecil Frank Powell, for his distinguished work in developing the photographic technique of detecting nuclear particles. Powell is at present Professor of Physics at the University of Bristol, England. Last year, he was the recipient of the Hughes Medal of the Royal Society of London.

Powell's early researches were concerned with the properties of ion, which led him to an investigation of fundamental particles and atomic nuclei using photographic plates. In this method the particles are detected by the tracks which they leave in the photographic emulsion, which can be observed through a microscope after the plate is developed. Powell played a large part in bringing about a marked

improvement in the quality of sensitive materials and also in the development of methods whereby the energy, mass and other characteristics of the particles can be actually measured. Using these improved plates, Powell discovered a new elementary particle, the π -meson, whose mass is 280 times that of the electron and of which both positively and negatively charged varieties exist.

Powell was instrumental in establishing the photographic method as a standard technique in nuclear research. Together with G. P. S. Occhialini, he has published a book entitled *Nuclear Physics in Photographs*, which contains a description of the technique, and also a large number of photographs illustrating various types of nuclear reactions.

RADIOACTIVE CALENDARS

NUCLEAR physicists have found a new and accurate method of dating history by using radioactive materials to supplement the archaeologist's pick and shovel.

The pioneer is Prof. W. F. Libby of the University of Chicago, who has been experimenting with his colleagues in this field for several years. In 1947, he announced that C^{14} , up to then known only as the product of nuclear bombardment in atom smashing machines such as cyclotrons or atomic piles, is found in every living thing. In fact, there is more radioactive carbon to be found in human beings, animals and plants than physicists are ever likely to make by transmutation in the laboratory.

The atoms in the air are bombarded continuously by cosmic rays, and the nitrogen atoms in the air are transformed by the impact of cosmic radiation into radio-carbon (C^{14}). Now this radio-carbon has a "half-life" of 5,000 years. It is known that living plants absorb all forms of carbon through their intake of carbon dioxide. Animals eat these plants and in this way return the carbon dioxide to the air. The C^{14} absorbed by organisms during their lives is not renewed, but decays slowly after death.

As the radio-activity of a given weight of

carbon derived from organic matter 5,000 years old is half that derived from carbon in living material, it is possible to determine the age of an object merely by measuring its radio-activity. Thus, a wooden object 2,500 years old will have lost a fixed proportion of its radio-activity, while another object, only 1,000 years old, will have lost less and will produce more radiations.

In other words, all carbon of biological origin is in a slight degree radioactive. Because the earth is at least 2.5 thousand million years old, it is assumed its atmosphere must have reached a stage of radioactive equilibrium centuries ago. That is, C^{14} atoms are produced at a rate equal to their rate of decay. This decay is the result of a loss of a β -particle, and they can be detected by a sensitive Geiger counter.

This radio-carbon method of dating can be used to supplement dating by the tree-ring method. With trees dated by the direct method the radio-carbon method has shown good agreement. In other cases, the discrepancy has been great, and it has been suggested that it would be an interesting experiment to treat Prof. Libby's method as established and use it to check dates calculated from incomplete tree-ring data.—(UNESCO.)

CLASSICAL MECHANICS*

OF late the feeling has been steadily growing among several critics that the present-day importance of classical mechanics as an essential part of the curriculum for students of advanced physics is undeservedly overpraised. Inasmuch as it neither introduces any new physical concept nor leads the student directly into current physical research, the post-graduate student is likely to regard it as redundant. Its aid in solving his problems on practical mechanics which may arise in the course of his laboratory work is insignificant.

Closer scrutiny, however, reveals that in the first place classical mechanics serves as the spring-board for the various branches of modern physics. Observe, for instance, that the technique of action-angle variables is very much needed in the older quantum mechanics while the Hamilton-Jacobi equation and the principle of least action transport you smoothly into the realms of wave mechanics; a proper formulation of the newer quantum mechanics is rendered easier by the use of Poisson brackets and canonical transformations. It enables the student to equip himself with many of the mathematical techniques needed for quantum mechanics while still working in terms of the familiar concepts of classical physics.

To bring out these aspects sharply, it is obvious that there ought to be a thorough overhaul of the traditional method of presenting the subject. In developing his course of lectures delivered at the Harvard University into the present book, Prof. Goldstein appears to have kept this aim constantly in mind and has succeeded admirably. The accent has throughout been on those formulations which are deemed important from the standpoint of modern physics; increased elegance and compactness have been frequently achieved by the introduction of special techniques normally associated with quantum mechanics.

The discussion of motion under a central force has been broadened to include the kinematics of scattering and the classical solution of scattering problems. Canonical transformations, Poisson bracket formulations, Hamilton-Jacobi theory, and action-angle variables have all been discussed in detail. A somewhat brief introduction has been provided to the variational principle formulation of continuous systems and fields.

One example of the application of new mathematical techniques may be seen in the discussion of the rigid body rotations from the standpoint of matrix transformations. As a result, the familiar Euler's theorem on the motion of a rigid body may now be presented in terms of the eigen-value problem for an orthogonal matrix. Such diverse topics as the inertia tensor, Lorentz transformation in Minkowski space, and resonant frequencies for small oscillations all become now capable of a unified mathematical treatment. Another advantage claimed by the matrix methods is that 'spinors' can be introduced in connection with the properties of Cayley-Klein parameters.

Quite often in the past, special relativity has received no connected development except as part of a highly specialised course which also covers general relativity. On account of its vital importance in modern physics, Prof. Goldstein has considered it an advantage to the student if he is introduced to this topic at a fairly early stage.

While the development of classical mechanics historically has mostly been with the emphasis on static forces dependent on position only (such as gravitational forces) we have on the other hand, in modern physics especially, to deal frequently with velocity-dependent electromagnetic forces. Potentials dependent on velocity have therefore been incorporated in the structure of mechanics from the beginning and consistently developed throughout.

There is today a real dearth of a connected account of the classical foundations of the variational principle formulation of continuous systems, despite its growing importance in the field theory of elementary particles. The theory of fields can be developed considerably both in extent and complexity before one finds the necessity to introduce quantisation. An adequate discussion of topics such as the stress energy tensor, momentum space representations, etc., all entirely within the frontiers of classical physics would normally need a scholarship much beyond what could be expected of the average student using this book. Chapter 11 is therefore limited to an elementary description of the Lagrangian and Hamiltonian formulation of fields.

Prof. Goldstein's excellent book is useful both for the inadequately prepared student and the ambitious senior frequently desirous of omitting the intermediate step. While a certain amount of discipline in advanced calculus and the elements of vector analysis is assumed on

* *Classical Mechanics*. By Herbert Goldstein. Addison-Wesley Press, Inc., Cambridge 42, Mass. 1950. Pp. xi + 399, Price 6.50 dollars.

the part of the student, more complicated mathematical tools are developed as and when their need is felt. A proper understanding of the sections dealing with electromagnetic forces necessarily presupposes an acquaintance with Maxwell's field equations and the simple results flowing from them.

The exercises appended to each chapter are more in the nature of extensions of the main

text illustrating some special point or proving a variant theorem. At the end of each chapter we find references for elaboration of the material treated.

It is, altogether, an exhilarating experience to read through the book and find that classical mechanics is still going strong.

P. S. R.

BUILDING RESEARCH CONGRESS, 1951

A COMPREHENSIVE Congress on Building Research has been planned to take place in September 1951, in London and will be to review the progress made in research in relation to architecture, building and the associated branches of civil engineering, and it has been arranged because of the widespread interest shown in the subjects in many countries since the end of war. There have been rapid developments in all branches of building science and papers presented at the Congress will review these developments and will consider their significance and their effect on future trends. Many of the papers will be contributed by authors from overseas, and it is expected that the Congress will attract many members from all over the world from amongst the ranks of architects, engineers, builders and contractors and from many branches of Science.

For the purpose of the technical sessions, the Congress has been planned in three divisions holding concurrent meetings.

DIVISION 1, which is concerned with the engineering and structural aspects of building, will cover the influence of mechanisation and prefabrication on techniques and cost of building; the influence of modern research on structural design; and the influence of modern soil studies on the design and construction of foundations.

DIVISION 2, which is concerned with building

materials, will cover individual materials such as burnt clay products, cement and concrete, building stones, lime, paints, plaster and timber, and there will be in addition a wide survey of research on weathering and durability of building materials.

DIVISION 3 will be concerned generally with the various factors which influence the comfort and efficiency of the people using the buildings. The matters to be discussed include the acoustics of auditoria and broadcasting studies; the heating and ventilating of buildings in relation to summer and winter conditions; the lighting of buildings. In addition three specific types of buildings—hospitals, factories and schools—will be considered in the light of all the requirements they must meet if they are to fulfil their purpose.

Since the Congress has been arranged during the Festival of Britain, it is expected that hotel bookings in the London area will be very heavy and in their own interests members are advised to lose no time in reserving accommodation.

The centre of the Congress will be the Institution of Civil Engineers. For the time being arrangements are being handled from the Building Research Station, D.S.I.R., and enquiries should be addressed to Organising Secretary, Building Research Station, Bucknalls Lane, Garston, Nr. Watford, Herts, England.

BUILDING RESEARCH INSTITUTE

DR. J. N. MUKHERJEE, till recently Director, Indian Agriculture Research Institute, has been appointed Head of the Division of Chemistry and Director of the Building Research Institute, it is learnt.

Dr. Mukherjee has had a long career of research in soil sciences which have an intimate bearing on problems relating to building research. It is hoped that with his appointment

the Building Research Institute, which is one in the chain of national laboratories being established under the auspices of the Council of Scientific and Industrial Research, and where a good deal of work has already been done on "low-cost houses and soil stabilisation", will be able to expedite the research programme undertaken by the Council.

MORE ACCURATE FIGURE FOR THE VELOCITY OF LIGHT

IN the famous experiment conducted by Michelson in 1935, a value of 1,86,271 miles per second was obtained for the velocity of light. This figure was confirmed in other experiments and has been accepted ever since. However, an experiment recently completed at the National Physical Laboratory, England, by Dr. Essen has shown that the accepted figure has to be raised to the extent of eleven miles per second.

The method used by Dr. Essen is similar in principle to Michelson's but, whereas Michelson used a tube a mile long, Essen's tube measured only seven inches. A radio wave was sent down this metal tube and reflected backwards and forwards between the two ends. When the time of travel between the ends equals the time interval between successive waves, they build up

to produce an electrical resonance which can be detected with very high precision.

The velocity of light was not wanted accurately for any practical purpose until the advent of radar in World War II. In radar, the distance to an object is calculated from the time taken by a pulse of radio waves to travel there and back, the speed of the waves being the same as that of light. The new figure will, therefore, enable radar to be used more accurately. This will be particularly valuable for aerial survey work where the shape of the ground is plotted by means of radar.

The velocity of light also is used in calculating a great number of physical constants, but the most significant changes will probably be in astronomy, in atomic research, and in the field of radio.

ZIRCONIUM FOR FRACTIONAL WEIGHTS*

THERE have been many attempts in the recent past to substitute other metals for platinum in fractional weights. Sheet metal weights of tantalum have been found to be very good. The possible use of zirconium as a material for fractional weights has been dealt with in a recent article in the *Journal of the Franklin Institute*.

The considerations which made the authors use zirconium are that the metal is similar to tantalum in its properties, possesses a high melting point and involves a small buoyancy correction. Four fractional weights from 10 mg. to 50 mg. have been made and compared with a standard fiducial weight. The intercomparison of the zirconium weights has been done by

the Benoit scheme. The experimental results given can be taken to be "acceptably accurate", and more data will throw the final light on the subject.

It is not generally known that at least 0.02 per cent. of the earth's crust is composed of zirconium. Though the element appears to be more abundant than commoner metals like copper, zinc or lead, it is a very costly metal to isolate and hence is classified as a rare metal. It must be remembered in this connection that the beach sands of Travancore are one of the richest sources of zirconium. If attempts are made to produce the pure metal in quantity in India, there seems to be no reason why our country should not take a lead in the manufacture of zirconium fractional weights, apart from harnessing the metal to other uses.

N. R. SRINIVASAN.

*Thornton and Haber *Jour. Franklin Inst.*, 1950, 250, p. 39.

THE INDIAN ACADEMY OF SCIENCES

THE Sixteenth Session of the Indian Academy of Sciences will be held in Hyderabad from December 29 to 31, 1950, at the invitation of the Osmania University. Sir C. V. Raman, President of the Academy, will deliver the presidential address.

The programme includes the inauguration of the Session on 29th December, addresses by foreign scientists and reading of papers in Sections A and B. A symposium on "Recent Advances in the Technique of Plant Breeding", has also been arranged.

INDIAN SCIENCE CONGRESS, 1951

THE Indian Science Congress has been invited by the Governing Council of the Institute to hold its Thirty-eighth Session in the picturesque, serene and inspiring premises of the Indian Institute of Science, Bangalore. The Session will be inaugurated on the 2nd January next and continue its deliberations for a little more than a week until the 10th. The Pan-Indian Ocean Congress, which was conceived during the last Session of the Indian Science Congress, will also meet at Bangalore during the same period.

His Highness, the Rajpramukh of the enlightened and progressive State of Mysore, has graciously agreed to be the Patron of the Congress.

Prime Minister Jawaharlal Nehru is expected to address the plenary session. Prof. H. J. Bhabha, F.R.S., Director, The Tata Institute of Fundamental Research, Bombay, is the General President-elect of the Session.

A distinguishing feature of the Indian Science Congress during the last few years, has been the attendance of eminent visiting scientists from foreign countries. This year, the delegations of visitors who are expected to participate in the proceedings of the Session, are both large and particularly distinguished. Those attending the International Congress on Element-

tary Particles, scheduled to be held in Bombay in the middle of December, have all been invited to attend the Bangalore Session. These include Professors P. M. S. Blackett, J. D. Cockroft, N. Feather, W. Heitler, R. Peierls, C. F. Powell and L. Rosenfeld from Great Britain, Professors L. Leprince-Ringuet, F. Perrin and P. Auger from France, Prof. Niels Bohr from Denmark, Professors C. Möller and H. A. Kramers from the Netherlands, Prof. U. G. O. Amaldi from Italy, Prof. W. Pauli from Switzerland, Professors G. Wentzel, H. H. Staub, M. Schein and N. L. Bowen from the United States and Prof. M. S. Vallarta from Mexico. Among the other visiting scientists are Prof. A. D. Ross from Australia, Professors A. W. Mail-vaganam and Baptiste from Ceylon, Professors R. A. Robinson and J. H. Strahen from Malaya and Professors A. Wald and R. Fieser from the United States.

It may be added that it is for the first time in the history of the Indian Science Congress, that a Research Institute—the Indian Institute of Science,—the premier Research Institute of India, has extended an invitation to the Congress. The credit of having taken this unusual and courageous step and establishing this new precedent, belongs to Prof. M. S. Thacker, Director, Indian Institute of Science, Bangalore.

FREEDOM FOR SCIENTISTS

THE real scientist is a creative artist. No one must boss him or drive him. Certainly arrange that his life be free from monetary worries; but let us remember that his life interest and pleasure is research. Leave him to carry on undisturbed by the stormy blasts and distractions of a quarrelsome world licking its wounds after a terrific fight. Do not let him be regimented by the politicians, even those of his own class. Then, the upward curve of research and discovery can continue unhampered, which it will never do if the spirit and vision of research are not free for advance. These will come through the exceptional man and he is often quite unappreciated by those of bureaucratic tendencies. There is an old Scottish pro-

verb, "Wha pays the piper, ca's the tune", and unless those who call the tune have a sympathy and understanding of the research instinct and the necessity for untrammelled development of its curiosity, the vast Government subsidies will be worse than wasted.

The present is indeed an age of stupendous advance, but granting the utmost to the creative genius of our time, we should never have run our mile, but for the furlong achieved by the pioneers of science in the last three generations. The past is important, the future is exciting, but the present interests us because we live in it.

—Courtesy of the *Journal of the Franklin Institute*,
October 1949, 248, No. 4, p. 354.

NUFFIELD FOUNDATION TRAVELLING FELLOWSHIPS FOR 1951-52

THE last date for receipt of applications for the Fellowships has been changed from

31st March 1951 to 28th February, 1951.

K. VYASULU, Secretary.

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A NOTE ON THE CRITICAL PRESSURE EFFECT IN COLLISIONS OF THE SECOND KIND IN MOLECULAR SPECTRA

TAWDE AND DESAI¹ observed selective enhancement of C_2 (Swan) bands in argon at a pressure of 15 mm. of the latter (Fig. 1). Later work in this laboratory using other rare gases indicates a similar behaviour, which may be tentatively explained as follows.

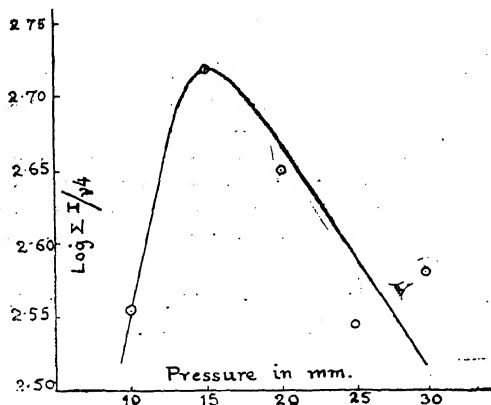


FIG. 1

We may assume, after Tawde and Desai, that collisions of the second kind are mostly responsible for the transfer of energy. In the present case, besides the ions and electrons (which

maintain the conductivity of the discharge) excited and unexcited argon atoms as well as carbon molecules are present in the discharge. The concentration of C_2 is negligible as compared to argon and the argon atoms thus take part in most of the collisions. In the positive column, the mean energy of the electrons is very low. Hence the chance of their exciting the argon atoms (11.5 volts) is small in comparison with the chance of exciting C_2 (2.5 volts). Most of these electrons being slow will make elastic collisions with argon atoms, but will have sufficient energy to excite C_2 molecules. Thus a large proportion of C_2 molecules will be excited by direct electron impacts and a small fraction by collisions of the second kind with excited argon atoms (metastable). The probability of the latter process is low as the energy levels of the two are further apart. In effect, the argon atoms play the role of increasing the path of the slow electrons by elastic collisions before getting lost at the walls or at the electrodes. As a consequence the probability of the electron meeting a carbon molecule and exciting it, is increased. The excited C_2 molecule deactivates by radiation or by collisions of the second kind.

With collisions increasing with pressure, more and more C_2 molecules get excited. Below 15 mm. the collision frequency is low enough for the time t between two successive

inelastic collisions to be relatively greater than the mean life-time τ of the excited state of C_2 . In this case after an activating collision occurs, there is little probability of further collisions occurring during the life time, and the molecule is left to deactivate by radiation. Hence the activation progressively increases with pressure until $(\tau - t)$ becomes zero in the close neighbourhood of 15 mm., at which t is equal to τ . Above 15 mm. t is less than τ and $(\tau - t)$ increases from zero to higher positive values. Here, after the molecule gets its first activating collision, chances of its making further collisions during the excited life time, increase. Thus there is a greater probability of its losing energy to a less energetic particle by collisions of the second kind before it radiates. This will bring about deactivation by inelastic collisions which increases progressively with pressure or with $(\tau - t)$ above 15 mm. The result will be progressive diminution in intensity of radiation. Thus we have a kind of critical effect at a pressure of 15 mm. of argon, at which it may be postulated that the time between two successive inelastic collisions is equal to the life time in the excited state. The life-time τ is considered to be invariable with pressure in molecular spectra according to Gaydon.²

Such a postulate is analogous to the Stern-Volmer³ condition for the quenching of resonance radiation and parallel to "close resonance" mechanism in collisions of the second kind in atomic spectra, supported by the experimental work of Beutler and Josephy⁴ and of Webb and Wang.⁵

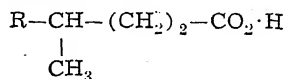
Spectroscopic Laboratories, N. R. TAWDE.
The Institute of Science, G. K. MEHTA.
Bombay,
October 4, 1950.

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2. Gaydon, "Spectroscopy and Combustion Theory," Chapman & Hall, 1942, p. 106.
3. Stern and Volmer, *Physik Z.*, 1919, **20**, 183.
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4-PHENYL-PENTANOIC ACIDS. γ -ARYL- γ -METHYL-BUTYRIC ACIDS

IN connection with some other work in these laboratories, it was found necessary to prepare γ -aryl butyric acids. By adoption of Eijkmann's procedure by which γ -methyl butyrolactone (I) was condensed with benzene and toluene in presence of aluminium chloride to corresponding γ -aryl butyric acids, it has been found

that (I) reacts readily with isomeric xylenes and other substituted aromatic compounds including tetraline to give excellent yields of the hitherto difficultly available compounds,^{1,2} as the following (II),



where R = 3 : 4-dimethyl phenyl (bp. 168-70/4 mm.); 3 : 5-dimethyl phenyl (bp. 170-1/4 mm.); 1 : 2-dimethyl phenyl (bp. 167-9/4 mm.); 1 : 2-dimethoxy phenyl (bp. 182-2/5 mm.); 3-methyl-6-methoxy-phenyl, (crystallised from benzene, mp. 91°-2°); 2-methyl-4-methoxy phenyl (bp. 183-5/5 mm.); 2 : 4-dimethoxy phenyl (bp. 190-2/5 mm.); crystallised from benzene, m.p. 72°-3°); 1 : 2 : 3 : 4-tetrahydro-7-naphthyl (bp. 192-5/4 mm.). By cyclisation of (II) with 80 per cent. sulphuric acid at 100° the following tetralones have been prepared: 4 : 6 : 7-trimethyl (bp. 150/4 mm.); 4 : 6 : 8-trimethyl (bp. 150-2/4 mm.); 4 : 5 : 7-trimethyl (bp. 146-8/4 mm.); 7-methoxy-4 : 6-dimethyl (bp. 157-4 mm.); 7-methoxy-4 : 6-dimethyl (bp. 157-9/4 mm.) and 5-methoxy-4 : 8-dimethyl (bp. 156-8/4 mm.) tetralone and also 4-keto-1 : 2 : 3 : 4 : 5 : 6 : 7 : 8-octahydrophenanthrene (bp. 167-9/4 mm.).

The presence of γ -methyl substituent in (II) appears to facilitate the formation of hydro-naphthalene ring as it is found, that, while methyl- γ -(2 : 4 dimethyl) phenyl butyric acid readily undergoes ring closure, γ -(2 : 4) dimethyl phenyl butyric acid is refractive under the same standard conditions.

The authors are indebted to Prof. J. C. Bardhan for his keen interest during this investigation.

Org. Chem. Labs., K. C. BHATTACHARYYA.
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May 5, 1950.

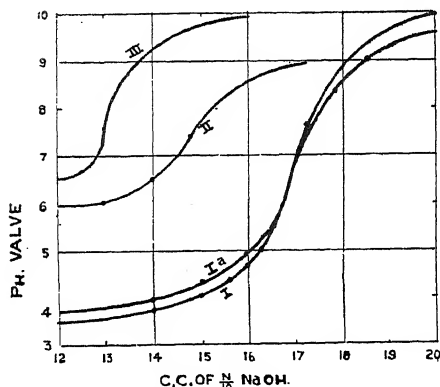
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ESTIMATION OF PARA-AMINO-SALICYLIC ACID

PARA-AMINO-SALICYLIC ACID, commonly known as PAS, has been found very efficacious in curing tuberculosis. An effort has been made to estimate it by the electrolytic titrations.

A roughly N/10 solution of para-amino-salicylic acid was prepared in a mixture of alcohol and water (1 : 4) and was titrated against

N/10 sodium hydroxide solution electrometrically. The curves obtained are given below.



- I. PAS from M/s. Hind Chemicals, Kanpur.
 II. PAS from M/s. P. J. Lobue Company, N.Y.
 III. PAS and Formal Dehyde.

Samples of PAS from two different sources were tried and all the curves give a very sharp point of inflection. On calculation the values obtained agree fairly with those given by the manufacturers.

The addition of formaldehyde to the solution gives a white precipitate, the sodium salt of which is soluble in water. The amount of alkali required to obtain point of inflection after the addition of formaldehyde is usually less than without formaldehyde. This behaviour is difficult to explain at this stage.

H. B. Technological Inst., M. S. BHATNAGAR.
 Kanpur, U.P., S. N. KAPOOR.
 September, 16, 1950.

ADSORPTION STUDIES ON METHANOL SYNTHESIS CATALYSTS.

I. Adsorption of Carbon Monoxide and Hydrogen on Zinc Oxide-Chromium Oxide Mixture

THE adsorption of hydrogen on zinc oxide and zinc oxide-chromium oxide catalysts has been investigated notably by Taylor and his co-workers. The adsorption of carbon monoxide on the mixed catalyst has, however, been left practically untouched, save for some comparative measurements by Taylor and Kistiakowsky.¹

The present communication concerns the adsorption of carbon monoxide as well as that of hydrogen on zinc oxide 75%-chromium oxide 25% (determined by a standard volumetric method) at close temperature intervals be-

tween 50° and 200° C. for carbon monoxide and upto 250° C. for hydrogen. The catalyst was prepared by precipitation from the solution of the mixed nitrates.

The results obtained show the occurrence of activated adsorption of carbon monoxide even at the lowest temperature studied, with an activation energy of 5 to 8.5 kcal. and a heat of about 6 kcal. for 0.9 c.c. adsn./g. The adsorption isobars of carbon monoxide at pressures below atmospheric show two maxima, one at about 52° and the other at about 178° C., thus revealing two distinct types of activated adsorption of this gas.

The results obtained with hydrogen compare favourably with those reported by Taylor and Strother² on a zinc chromite catalyst prepared from zinc nitrate and ammonium chromate. Activated adsorption has been observed even at the lowest temperature, the heat of adsorption being about 10 kcal. for 1.30 c.c. adsorption per gram and the energy of activation being about 8.5 kcal. for 1.19 c.c. adsorption per gram at 37 cm. pressure. In contrast with the observations of Taylor and Burwell³ it was found that the energy of activation decreased with increase of pressure, the values for 1.19 c.c. adsorption per gram at 47 cm. pressure being 4.7 kcal. The maximum adsorption of hydrogen was observed at 204° C.

The present catalyst was found to be more adsorptive than that of Taylor and Strother,² and, in contrast with the observations of Garner and Kingman,⁴ it adsorbed hydrogen rather more than carbon monoxide. Both hydrogen and carbon monoxide adsorptions increased steeply with pressure and showed no tendency to attain saturation as reported by Taylor and Kistiakowsky.¹

The surface area of the catalyst, as found by the Brunauer-Emmett-Teller method using argon at liquid air temperature, gave a value of 30.68 sq.m./g.

One of us (S.V.) is thankful to the National Institute of Sciences of India for the award of a Fellowship.

Gen. Chem. Section,
 Indian Inst. of Science,
 Bangalore-3,
 October 30, 1950.

J. C. GHOSH.
 M. V. C. SASTRI.
 S. VEDARAMAN.

1. Taylor and Kistiakowsky, *J. Am. Chem. Soc.*, 1927, **49**, 2468. 2. Taylor and Strother, *Ibid.*, 1934, **56**, 586. 3. Burwell and Taylor, *Ibid.*, 1936, **58**, 697. 4. Garner and Kingman, *Trans. Faraday Soc.*, 1931, **27**, 322.

ADSORPTION OF NITROGEN AT ELEVATED PRESSURES ON A PRO- MOTED IRON SYNTHETIC AMMONIA CATALYST

In the synthesis of ammonia on iron catalysts, the formation of a "surface nitride", consisting essentially of chemisorbed nitrogen atoms, has been considered to be the important rate-determining step.¹ Although activated adsorption of nitrogen on various types of iron catalysts has been noted by many experimenters,^{2,3} a systematic study of the isotherms at a number of temperatures in the range of appreciable occurrence of the phenomenon has not been reported so far. Emmett and Brunauer² studied the adsorption of nitrogen on a doubly promoted iron catalyst at only two temperatures (400° and 450° C.), but the presence of chemisorbed hydrogen on the surface on which the nitrogen adsorption was determined, and the indirect technique employed by them in the high pressure measurements detract considerably from the reliability of their data. The present communication reports briefly the results of more accurate determinations of the adsorption isotherms of nitrogen on a $\text{Fe} - \text{K}_2\text{O} - \text{Al}_2\text{O}_3 - \text{TiO}_2$ catalyst at seven temperatures between 50° and 350° C. and over the pressure range from 15 to 50 atmospheres, employing the direct volumetric technique developed by the present authors.⁴

While the adsorption at the lower pressures (20 and 30 atmospheres) exhibits only two maxima at about 150° and 300° C. respectively, at the highest pressure employed, viz., 50 atmospheres, three maxima are observed at 100°, 200° and 300° C. This indicates the occurrence of three types of activated adsorption on the same catalyst, corresponding probably to chemisorption on iron atoms in the three possible dispositions in the (111) plane.⁵

Since nitrogen might be expected to adsorb on the same iron atoms as hydrogen, the value of 0.4 c.c./g. for the maximum surface adsorption calculated in the case of hydrogen⁴ could be deemed to hold for the adsorption of nitrogen also. It has been found in the present investigation that the adsorption of nitrogen is for the most part below the surface saturation limit, thereby suggesting that absorption of nitrogen, as distinct from adsorption, is not considerable even at the highest pressure employed. This view receives further support from the fact that, at least upto 30 atmospheres, the volume adsorbed at several temperatures between 150° and 350° C. conform to the Brunauer, Love and Keenan equation⁶ which

has been based on the concepts of surface adsorption and desorption.

For an adsorption of 0.05 to 0.15 c.c./g. at 20 atmospheres, a value of 23 k.cals. is obtained for the isobaric heat of adsorption. This value may reasonably be compared with that of 35 k.cals. obtained by Emmett and Brunauer² for their doubly promoted catalyst.

The authors are very thankful to Sir J. C. Ghosh and to Prof. B. Sanjiva Rao for their kind interest and encouragement.

Gen. Chem. Section, M. V. C. SASTRI.
Ind. Inst. of Science, H. SRIKANT.
Bangalore-3,
October 30, 1950.

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EFFECT OF REDUCING AGENTS ON THE VIRUS OF NEWCASTLE (RANIKHET) DISEASE. 1. ASCORBIC ACID, 2. CYSTEINE HYDROCHLORIDE

THE fact that lemon juice exerts virucidal action on Rabies virus is well-known. The application of lemon juice in wounds produced by the bites of rabid dog has been reported to be efficacious in Ceylon. The precise information as to whether such effects are due to ascorbic acid or other acids contained in lemon is not clear. However, recent work on PR8 strain of influenza virus shows that ascorbic acid exerts virucidal action.¹ The toxic action of ascorbic acid on the virus is due to the formation of hydrogen peroxide when ascorbic acid is oxidised. When hydrogen peroxide is added in a concentration in which it is formed during the oxidation of ascorbic acid, the inimical action is found to be alike. This is accentuated by the addition of copper. KCN inhibits the action of ascorbic acid due perhaps to the formation of complexes with copper. Information regarding the effect of cysteine hydrochloride on viruses is not yet known.

Observations were carried out to determine the effect of ascorbic acid and cysteine hydrochloride on the Newcastle (Ranikhet) disease virus. Amniotic fluid of infected chick embryo was used and the viability of the treated virus was tested on susceptible chicks, 6-8 weeks in age.

Ascorbic acid was used in the concentration of 0.05 mg./c.c., 0.1 mg./c.c., 0.2 mg./c.c. in glass distilled water. The pH of the solution was adjusted between 7.4-7.6. Cysteine hydrochloride was also used in the above strengths. The procedure was to tube 9 c.c. quantities of either ascorbic acid or cysteine hydrochloride and subsequently add virulent Newcastle disease virus in order to make up a final dilution of 10^{-5} i.e., 100 M.L.D. contained in 0.5 c.c. The virus and the ascorbic acid/cysteine hydrochloride mixture was stored aerobically or anaerobically (in McIntosh and Fildes Jar) and kept at 5°, 15°, 32° and 37° C. for 24 hours. At the end of this period the mixture was injected in susceptible birds and the virus was found to be alive and still virulent.

Full details of this work will be published later.

Indian Vet. Res. Institute, K. C. SINHA.
Mukteswar—Kumaon, U.P., S. DATTA.
August 25, 1950.

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ANTIGENIC PROPERTY OF IRRADIATED NEWCASTLE (RANIKHET) DISEASE VIRUS

Good results have been reported in literature regarding the use of irradiated distemper virus (mink distemper) as a vaccine. Psittacosis virus, when exposed to ultraviolet rays, retains its antigenic structure intact and can be used to immunize mice.¹ These observations are interesting in view of the fact that wider application of physical agents may aid in the study of viruses better than hitherto done.

Trials were carried out at Mukteswar to see whether irradiated Newcastle disease (Ranikhet) virus of poultry can be used as a vaccine. Virus suspension was irradiated by alpine homesun lamp model VIII (Hanovia). No filters were used for this work.

The procedure consisted of using a 10^{-5} dilution in saline (0.85%) of the virus contained in the amniotic fluid of the chicken embryo. 1 c.c. quantities of this virus suspension were irradiated for 1-8 minutes at a distance of 36 inches from the object to the arc. The irradiated virus in the dose of 0.5 c.c. (100 M.L.D.) was inoculated into 6-8 weeks old chicks. It was found that the virus was fully alive even after irradiation for 6 minutes and such virus samples, when injected, killed chicks. After 7-8 minutes of irradiation, the virus failed to kill chicks. The immunity conferred by

this irradiated virus was tested. It was observed that the immunogenic property of the virus was lost during irradiation.

Fuller details will be published elsewhere.

Indian Vet. Res. Institute, K. C. SINHA.
Mukteswar—Kumaon, U.P., S. DATTA.
August 25, 1950.

1. Francis, R. D., Milzer, A. and Gordon, *Proc. Soc. Exp. Biol. Med.*, 1947, 66, 184.

SOME RECOMMENDATIONS ON THE CONTROL OF TERMITES IN SUGAR- CANE

BASED on observations over a period of sixteen years, the following recommendations are made towards the control of termites, particularly during the period of germination in the hot weather. They have been successfully tested in the cultivators' fields:

Lime and Lead Arsenate.—2 oz. of lead arsenate is mixed with 20 oz. of lime in 30 lb. of water. The setts are planted after soaking them in this solution for 24 hours. This gives quick and good germination and it is specially beneficial in cases where planting has to be done in fields deficient in moisture or in cases of late plantings.

Phenyle.—One gallon of 'phenyle' is mixed with 50 gallons of water and then the setts are soaked in this solution for 24 hours before planting. It has been found to accelerate germination due to its stimulating effect and also affords considerable protection against termites.

Mercuric chloride.—A 0.25% solution of this chemical has been found to give good germination besides preventing damage to eye buds and ends. 2 oz. of this powder is dissolved in 50 lb. of water to get the desired strength. The cane setts are dipped in the solution and planted when dry. Prolonged soaking is unnecessary.

D.D.T.—A 2.5% emulsion or suspension of D.D.T. has proved to be very effective in preventing the termite damage to eye buds and ends. The setts are planted after dipping them once in the solution.

Benzene-hexachloride.—A 5% dust of benzene-hexachloride (Gammexane D025) has been used with very good results. This powder is applied in furrows at the rate of 20 lb. to an acre before planting.

The effects of these treatments on the germination of eye buds, tillering and cane formation are always very encouraging particularly in plots treated with lime plus lead arsenate, phenyle or corrosive sublimate. An increase in yield from 9 per cent. to 19 per cent. has

also been recorded. The cost of treating the setts per acre is approximately Rs. 10 to Rs. 15 except corrosive sublimate, the application of which costs only Rs. 2-8-0 per acre.

Thanks are due to Dr. B. K. Mukherjee for his guidance and to I.C.A.R. and I.C.S.C. for financial assistance.

Main Sugarcane Res. Station, B. D. GUPTA.
Shahjahanpur,
August 5, 1950.

A NEW SPECIES OF ASCOCHYTA

DURING a routine plant collection tour round Simla, *Cyathula tomentosa* Moq. plants were found affected with a leaf-spot disease, due to an *Ascochyta* sp. No species of this genus has been reported so far on this host, or on closely related plants. The description of the fungus is, therefore, presented below. Being a new record, it is proposed to name the fungus as *Ascochyta cyathulæ* sp. nov. Figure shows pycnidia and pycnospores.

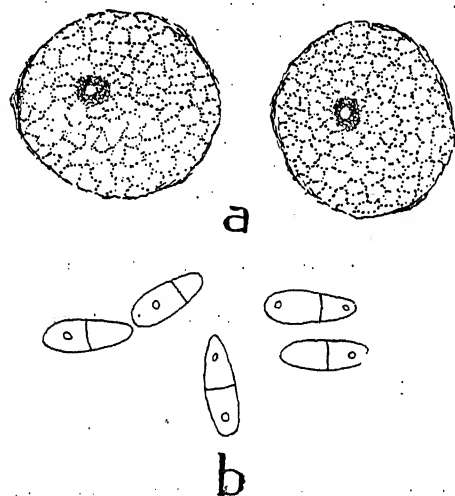


FIG. 1. *Ascochyta cyathulæ*.
(a) Pycnidia $\times 280$.
(b) Pycnospores $\times 1740$.

Ascochyta cyathulæ sp. nov.

Spots light brownish, raised, circular, later coalescing; older spots with discoloured centres and brown margins, 8-15 mm. in diameter. Pycnidia epiphyllous, in discoloured spots, globose, smooth, 100-180 \times 90-150 μ , membranous, Buckthorn brown to Cinnamon brown (Ridgway), ostiolate, pore prominent, 15-21 \times 14-16 μ . Cells around the ostiole dark-brown in colour, pycnidial wall parenchymatous. Spores hyaline, oblong, 1-septate; septum distinct; both ends rounded usually; sometimes lower end acute; one or two oil globules pre-

sent; immature 1-celled spores 5-6 \times 2 μ , mature 2-celled spores 7-8 \times 3 μ .

On leaves of *Cyathula tomentosa* Moq., Flowerdale, Simla 13-xi-48 (R. L. Munjal). Type deposited in Herb. Crypt. Ind. Orient., Indian Agricultural Research Institute, New Delhi.

Maculae pallide brunneae, elevatae, circulares, postea coalescentes, vetustiores, maculae medio discolorato et marginibus brunneis, 8-15 mm. diam. Pycnidia epiphylla, in maculis discoloratis, globosa, laevia, 100-180 \times 90-150 μ , membranacea, Buckthorn brunnea and Cinnamomo brunnea (Ridgway), ostiolata, poro prominenti, 15-21 \times 14-16 μ . Cellulae circum ostiolum obscure brunneae, parietibus pycnidii parenchymaticis. Sporis hyalinis, oblongis, quarum una est septata, septo distincto, utroque apice rotundato vel nonnumquam inferiore apice acuto, presentibus uno vel duobus globulis olei; immaturis 1-cellulatis sporis 5-6 \times 2 μ , maturis vero 2-cellulatis sporis 7-8 \times 3 μ .

Habitat in foliis *Cyathulae tomentosae* Moq., in loco Flowerdale, Simla, 13-xi-48 (R. L. Munjal). Typus positus in Herb. Crypt. Ind. Orient., Indian Agricultural Research Institute, New Delhi.

Our grateful thanks are due to Dr. R. S. Vasudeva, Head of the Division of Mycology and Plant Pathology, for helpful criticism and suggestions, and to Rev. Fr. H. Santapau, S.J., Head of the Department of Biology, St. Xavier's College, Bombay, for Latin diagnosis.

Div. of Myc. & Plant Path., B. L. CHONA.
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New Delhi,
July 31, 1950.

EARLY STAGES OF GROWTH OF WHEAT PLANTS AFTER VERNALISATION

THERE has scarcely been any serious attempt to study the growth of the plants at an early stage after vernalisation. A preliminary investigation was carried out in order to study the effect of vernalisation on the growth of wheat plants (*Triticum vulgare*, var. Holdfast), especially at the early stage. In connection with a work on bulk-vernalisation, a sample of the vernalised seeds of the 'Holdfast' wheat were sown in soil contained in rectangular wooden boxes. The boxes were kept in a temperature-controlled glasshouse. The vernalised seeds were sown in four rows having six plants in each row. Seeds, soaked for six hours in water at the room temperature and sown similarly, served as the 'control' set. It was found previously that the water content of the vernalised

seeds was the same as that of the unvernalsed ones when the latter were soaked in water for six hours at the room temperature. Bulk-vernalisation was done by exposing the soaked seeds for a period of twenty-one days to 0° C. within a constant-temperature cold-room at the Low Temperature Research Station at Cambridge. After sowing, regular observation and germination-count were made and the height of the plants were measured at two days' interval. The results are tabulated below and graphically represented in Fig. 1.

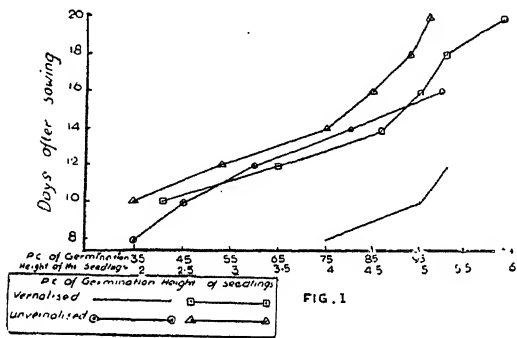


FIG. 1

The results indicate that the germination rate was distributed through several days in case of the unvernalsed seeds, but it was far too rapid in case of the vernalised ones. Cent per cent. germination was reached at by the

general observations and by splitting open the coleoptile lengthwise respectively. It was found that although the pattern of growth was similar in both the cases, there was a striking difference in the behaviour of the plants as regards their growing-points. In the seedlings developed from the vernalised seeds, the growing-points were elongated and pushed up much above the soil-level within a fortnight after sowing, whereas in those from the unvernalsed ones, they did not elongate, and remained at the soil-level.

Evans and Grover¹ (1940) noted that in grasses the growing-point elongated rapidly and that there was an increase in its diameter at the approach of the period of transition from the vegetative to the reproductive phase. They also referred to the importance of the length of day, among the various other environmental factors, in determining the time of initiation of the reproductive phase in the plants. As the plants, developed from the vernalised wheat seeds, flowered earlier than those from the unvernalsed ones, it is expected that the former would have the growing-point elongated much earlier than the latter. The conclusion, reached at by the present author also corroborates this result, but the elongation of the growing-point in the 'Holdfast' wheat took place much earlier than was to be expected according to Evans and Grover (1940). The increased rate of growth and the elongation of the growing-point from

Percentage of germination							Growth measurements (in cm.)						
							Length of coleoptile	*Height of the plants					
								Days after sowing					
Seeds	8	10	12	14	16		10	12	14	16	18	20	
Vernalised	..	75	95	100	..	..	1.42	2.3	3.5	4.6	5.0	5.3	5.9
Unvernalsed	..	35	45	60	80	100	1.02	2.0	2.9	4.0	4.5	4.9	5.1

* Length from the soil-level upto the tip of the first green leaf.

vernalsed seeds within twelve days, whereas it took sixteen days for the unvernalsed seeds to reach that level. The length of the coleoptile as well as the height of the plants were greater in seedlings developed from the vernalised seeds than those from the unvernalsed ones at every stage of growth, the difference being almost similar at every stage, as can be seen from Fig. 1.

Observations were made on the pattern of growth and also on the growing-point of the seedlings by

the very outset and continued through every stage of growth and development, are perhaps, responsible for the early tillering and the initiation of the reproductive phase at an early date in case of the vernalised plants.

Division of Botany, D. K. MUKHERJI.
New Delhi, August 25, 1950.
Indian Agric. Res. Inst.,

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THE DEVELOPMENT OF THE FEMALE GAMETOPHYTE IN *COUROUPITA GUIANENSIS* AUBL.

THE present account corroborates in all essential features Mauritzon's¹ observations on the ovule, integuments, nucellus and the integumentary jacket in *Couroupita guianensis*. The points not recorded by Mauritzon are, the rare occurrence of two megaspore mother cells side by side in the same nucellus and the presence of 18 bivalent chromosomes during the first division of the MMC. In contrast to the findings of Mauritzon, the megaspore nuclei derived from the micropylar dyad cell are separated by a wall. The chalazal megaspore gives rise to an eight-nucleate embryo-sac. The synergids are characterised by pointed ends and basal vacuoles. The egg is comparatively smaller in size and occupies a central position below the synergids, while the primary endosperm nucleus lies close to it. The antipodals are small and degenerate very soon. The pollen grains have three germ pores and are binucleate at the time of shedding.

Department of Botany,
Calcutta University,
October 19, 1950.

I. BANERJI.

1. Mauritzon, J., *Lunds Univ. Årsskr.*, N. F., Bd., 1939, 35 (2), 90-85.

HYGROMETRIC PROPERTIES OF SOME CAPILLARY SYSTEMS

HAIR hygrometers work on the principle that hair, on account of its capillary structure, absorbs moisture from the atmosphere and undergoes proportionate extension in length. To explore the possibility of extending this principle to the measurement of the vapour pressures of the common organic liquids, the hygrometric behaviour of a human hair and fibres of cotton, silk and nylon was studied in the vapour phases of different liquids.

The hair as well as the three fibres, 60 cm. in length, were mounted vertically in a glass tube and, to give a proper stretch, a sewing needle was attached, in each case, to the lower end, which was kept just below the opening of the tube. A stream of dried air was charged with vapour of a particular liquid and was then led over the fibres in the tube. The fibres showed gradual extensions in length and in about half an hour, acquired constant positions which was determined by means of a travelling microscope. The values of the extensions produced in the atmospheres of saturated

vapours of water and eight common organic liquids are given in Table I.

TABLE I

Extension of human hair and fibres of cotton, silk and nylon in atmospheres of saturated vapours of different liquids

Extensions in cm./100 cm.

Liquid	Hair	Cotton fibre	Silk fibre	Nylon fibre
Water	.. 0.960	0.900	1.372	0.850
Methyl alcohol	.. 0.282	0.400	0.221	1.366
Ethyl alcohol	.. 0.288	0.420	0.122	1.266
Butyl alcohol	.. 0.251	0.375	0.115	1.082
Amyl alcohol	.. 0.222	0.370	0.102	0.975
Acetone	.. 0.301	0.408	0.140	0.555
Ether	.. 0.002	0.014	0.460	0.458
Benzene	.. 0.024	0.036	0.550	1.201
Xylene	.. 0.017	0.028	0.590	1.302

It is seen that hair does not undergo any appreciable extension in the vapours of ether, benzene and xylene. Of all the substances studied, nylon fibre is seen to be the best hygroscopic substance since its extension is largest in the case of all the organic liquids tried and is of the same order as the other fibres with water vapour.

To test its suitability for measuring vapour pressures of different liquids, its extension was determined in atmospheres of different vapour pressures of water, methyl alcohol, ethyl alcohol and ether. It was found that in the case of all the four liquids, the increase in length of the fibre, with corresponding increase in the vapour pressure of the atmosphere, is continuous, regular and appreciable. Nylon can, therefore, be used for measuring vapour pressures of water and the common organic liquids.

To determine the factors influencing the extension of a capillary system in a vapour phase, the amounts of the vapours of different liquids taken up by hair and nylon fibre were determined by placing known weights of these substances over different liquids contained in vacuum desiccators. The increase in weight was determined after about an hour when it had become constant. The results are given in Table II, where p is the percentage by weight absorbed of the vapour and e is the value of corresponding extension, reproduced from Table I. It is found that $\frac{e}{\gamma \cdot p}$ is nearly the same for all liquids, where γ is the surface tension. It appears, therefore, that besides the amount of the liquid absorbed, its surface tension also has an appreciable effect on the

TABLE II

Absorption of different liquids from vapour phase by hair and nylon fibre and their corresponding extensions

Liquid	Hair				Nylon			
	Extension cm. (<i>e</i>)	% Absorption (<i>p</i>)	$\frac{e \times 10^5}{* \gamma \cdot p}$		Extension cm./100 cm. (<i>e</i>)	% Absorption (<i>p</i>)	$\frac{e \times 10^5}{* \gamma \cdot p}$	
Water	0.960	21.81	60		0.850	10.1	115	
Methyl alcohol	0.282	21.60	57		1.366	48.6	122	
Ethyl alcohol	0.288	21.39	60		1.266	46.8	120	
Butyl alcohol	0.251	20.14	54		1.082	39.0	120	
Amyl alcohol	0.222	18.41	55		0.975	37.4	118	
Acetone	0.301	21.70	58		0.555	22.4	104	
Ether	0.092	0.20	60		0.458	22.8	121	
Benzene	0.024	1.6	52		1.201	39.1	106	
Xylene	0.017	1.1	54		1.302	42.8	106	

* γ is surface tension of the liquid.

magnitude of the extension of a fibre—larger surface tension producing greater effect for a given weight of the liquid absorbed.

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August 16, 1950.

ON THE SOMATIC CHROMOSOMES OF SOME NON-TUBEROUS SOLANUM SPECIES

THE somatic metaphase plates of three species *S. Seaforthianum*, *S. Warszewiczii* and *S. Verbascifolium*, are respectively illustrated in Figs. 1, 2 and 3. Fig. 4 represents a tetraploid



cell from *S. Verbascifolium*, a case of somatic duplication. The chromosome number of the first two species has been reported as being $2n = 24$ by Bhaduri (1933) and Tischler (1927) but the morphology of chromosomes has not been described before. The chromosome num-

ber of *S. Seaforthianum* also was found to be $2n = 24$ by the present writer.

When compared to the species of the tuberos group (Sinha, 1950), the chromosomes of the present species resemble in many respects. There can be seen in each one two pairs of chromosomes with a secondary constriction which although is not so clear in the case of *S. Seaforthianum*. The rest of the chromosomes have either a median, sub-median or sub-terminal constriction. In size and general morphology, the chromosomes of *S. Warszewiczii* and *S. Seaforthianum* (Figs. 2 and 1) resemble those of the diploid tuberos species, whereas the chromosomes of *S. verbascifolium* (Figs. 3 and 4) are much bigger and also somewhat different karyotypically. The position with regard to the number of satellites also appears to be similar in not being the same in the three species. One satellited-chromosome is to be seen each in *S. Seaforthianum* and *S. Verbascifolium* and two in *S. Warszewiczii*. The tetraploid cell shows two satellites borne on the same type of chromosomes as in the diploid species. In *S. Warszewiczii* and *S. Seaforthianum*, however, the satellites are borne on chromosomes with median and sub-median spindle-attachment respectively.

Dept. of Botany, N. P. SINHA.
King's College,
University of Durham,
Newcastle-on-Tyne,
England, October, 1949.

1. Bhaduri, P. N., *J. Ind. Bot. Soc.*, 1933, 12, 56-64.
2. Tischler, G., *Tabulae Biologicae*, 1927, Band. 4, 43-44.
3. Sinha, N. P., *Ph.D. Thesis, Univ. Durham England*, 1950, 105-07.

REVIEWS

A Concise History of Astronomy. By Peter Doig. (Chapman & Hall, London), 1950. Pp. xi + 320. Price 21 sh. net.

Astronomy has made considerable strides during the last fifty years, and a book briefly surveying the historical development, and summarising the present state of knowledge of the subject was in great need. As the author mentions, "No general history of the kind has appeared in English for forty years". The present volume will thus receive the welcome it deserves.

The first few chapters are devoted to a brief survey of early astronomical work. The work of the Newtonian period and of the 18th century, including the work of William Herschel is treated in some detail in four chapters. Three chapters are devoted to the astronomical discoveries of the 19th century, and refer not only to the facts discovered during the period, but also to the improvements in astronomical instruments and methods of observation. The astronomical facts in particular give a survey of planetary phenomena, measurements of solar and stellar parallax, and of cosmogony in general as known during the century. Four chapters deal with the progress in the 20th century, and present to the reader an up-to-date knowledge as regards the planetary system, and the structure and theories of the stellar universe. The chapters dealing with the work of the 19th and 20th centuries comprise evidently the most valuable portion of the book, and persons who are not specialists in astronomy will find here an authoritative and readable account of the progress and present state of knowledge of the subject.

But some of the author's views on the early history of astronomy are unfortunate, and will meet with serious criticism, at least from the scholars of the nations concerned. No history is worth anything if it is written by one who has not read the original sources in the languages of those nations, but comes to conclusions from the accounts written by others who were similarly ignorant of the originals and have often viewed matters with insufficient data and through coloured spectacles. The author happily remarks in one place, "It seems well to remark that the history of ancient science and even the general histories of early civilizations such as China, Egypt, . . . are in many respects not yet too well-founded. . . . In many instances,

scientific history is completely antiquated and at best enjoyable for its literary style". These remarks of the author must perforce be applicable to his own work. We give the following statements by the author, which concern India:

P. 41. "An Indian treatise on Astronomy (the author presumably refers to Brahmagupta's *Brahma Sphuta Siddhanta*) based largely on Greek knowledge was translated into Arabic and became a text-book for students."

P. 44. "The introduction of the decimal notation with a consequent enormous simplification of arithmetic was due to the Arabs."

Comments are unnecessary. It is enough to remark that articles and books on Indian Mathematics written in English by Indian scholars are available for the author's perusal.

C. N. S.

Weltsystem, Weltäther und die Relativitätstheorie. (World System, Ether and Relativity Theory). By Karl Jellinek. (Wepf & Co., Verlag, Basel), 1949. Pp. 445. Price Sw. Fr. 45.00.

This is a companion volume to the author's book on Wave Mechanics* and is likewise intended to be an introduction for experimenters. However, the book is sure to find a much wider use, since it contains a very logical and systematic development of both special and general relativity theories. It fills the gap that exists at present between the advanced treatises on the subject and various semi-popular accounts. While great stress is laid on the basic physical concepts, equal attention is paid to the mathematical development of those ideas. In order that the comparatively uninitiated may follow the book, more advanced portions are preceded by a development of the necessary mathematics; for instance, there is a chapter of twenty pages on tensor analysis.

Starting with introductory chapters on reference systems and the ether, the earlier part of the book is devoted to a thorough discussion of special relativity theory in relation to both mechanics and electrodynamics. Then follow an account of the general theory and the mathematical derivation of the three famous consequences of it, namely, precession of the perihelion of mercury, the curvature of a light

*Reviewed in *Curr. Sci.*, 1950, 19, 328.

ray in a gravitational field and the Einstein red shift. In the end, about a hundred pages are devoted to a description of the various relativistic cosmologies, including a short account of Milne's kinetic universe.

In certain respects, the treatment in the book is unorthodox. The author assumes that there exists a "world reference system, with respect to which all heavenly bodies, on the average, remain stationary" and that there is a "world-ether which, as a whole, is at rest in the world reference system". It is claimed that neither of these assumptions has been disproved and that the theory is more consistent when they are introduced. While it is true that they do not contradict any known facts, the reviewer does not find any particular advantage gained by their introduction, as the mathematical structure of the theory is unaltered. For instance, the equations of motion in the so-called "world reference system" is exactly the same as those in any other system in uniform motion relative to it and one does not see any justification in singling out that system alone.

In spite of this deviation from orthodox ideas, the book could be read with profit by anyone aspiring to have a good background of relativity theory.

G. N. RAMACHANDRAN.

Communication Circuit Fundamentals. By C. E. Smith. First Edition. (Published by McGraw Hill Book Co., Inc., New York, Toronto and London), 1949. Pp. x + 401. Price \$5.

This book is a very welcome addition to the available literature and represents the typical text-book that can go safely into the hands of a beginner. The treatment is everywhere very lucid, the use of advanced mathematics being avoided. It is, therefore, most useful to our diploma students in electrical engineering, who need to know the basic principles of communication circuits, etc.

The book is divided into twenty chapters. The first fourteen chapters are devoted to electricity and magnetism, a.c. and d.c. theory and series, and parallel circuits. This is followed by a chapter on network theorems. The last five chapters are devoted to thermionic emission, diode, triode, multi-element tubes and cathode ray tubes. The proportion of space devoted to tubes is very small and it is to be hoped that these chapters will be expanded considerably in a subsequent edition.

The printing and get-up of the book are excellent. On page 257, in figure 15.4 (a), Z_0 should really be Z_g . This is really of no

significance, but it is important in books meant for beginners.

S. V. CHANDRASHEKHAR AIYA.

Physico-Chemical Constants of Pure Organic Compounds. By J. Timmermans. (Elsevier Publishing Co., Amsterdam), 1950. Pp. viii + 693. Price 95 sh.

As Director of the International Bureau of Physico-chemical Standards, which has been functioning for over twenty-five years, Prof. Timmermans is in a unique position for compiling this book. It is obvious that he has carried out his laborious task with the utmost care and with expert knowledge of the criteria of purity and the precision of the available data on the basis of which a few hundred organic compounds have been chosen from among the hundreds of thousands which have so far been synthesized or isolated from natural sources. In an earlier publication (*La Notion d'Espèce en Chimie*, Gauthier-Villars, Paris, 1928), Timmermans has described the precautions to be taken for a constant to "acquire the character of a real physico-chemical standard". The original reference for each constant is cited, and in an introduction to the bibliography the history of the investigation of the physical constants of pure organic compounds is traced. The ordinary organic chemist is content with determining the melting point of a compound within a degree or two, but schools of research on the properties of petroleum hydrocarbons, constants of pure gases, heats of combustion, and other physico-chemical properties of organic compounds have also been in existence. Some of the data cited in the book under review are those obtained by W. H. Perkin, Young and others in the last century—a remarkable tribute to the precision of their work. National laboratories, such as the Bureau of Standards at Washington, have now undertaken such work as a special responsibility, and the International Union of Pure and Applied Chemistry has set up permanent commissions for such studies.

The following are some examples of the criteria of purity. The boiling range must not exceed one-tenth of a degree. Samples are rejected if the saturated vapour pressure changes by more than 1/500th of its value from the beginning to the end of the isothermal liquefaction or vaporization. The freezing or melting point must be within a range of a tenth of a degree. The specific weight referred to its value in vacuo should be known to within 0.02%. Data are not recorded unless the paper from which they are taken contains sufficient

details of the method of determination to enable the precision to be judged. The constants are listed in the following order: constants of heterogeneous equilibria (b.p., saturated vapour pressure, critical temperature and pressure, freezing or melting point), constants in the vapour, liquid and crystalline states (specific weight, viscosity, surface tension, refractive index, dielectric constant, specific rotatory power, magnetic susceptibility), and finally heat constants.

There are a few printing errors, such as the density in the liquid state quoted at -136.5° while the freezing point is given as -129.7° (p. 33); specific heat quoted for the liquid state at -169.60° and -155.75° (p. 49) while the freezing point is 153.71° (p. 48); crystallizes (p. 139); iodine instead of iodide at the end of line 2, para. 3, in p. 210; (CHBr_2) instead of (CHBr_2)₂ in p. 245; iso- used for *trans*- and not *cis*-crotonitrile (p. 543); Merskx instead of Merckx (p. 650). For stearic acid the melting points cited range from 69.2 to 69.9° , but there is no indication of the constant to be chosen.

K. V.

The Chemistry of the Acetylenic Compounds.
Vol. II. *The Acetylenic Acids.* By A. W. Johnson. (Edward Arnold & Co., London), 1950. Pp. 328. Price £2-10-0.

Unlike the acetylenic hydrocarbons, the acetylenic alcohols, acids and their derivatives are safe to handle and comparatively easy to prepare. Because of their reactivity and their great utility for synthesis, the chemistry of the acetylenic compounds has attracted wide attention in recent years and Dr. Johnson's review of the subject is very valuable. Acetylenic compounds occur more frequently in nature than one might have anticipated from a consideration of the explosive character of the parent hydrocarbon. As stated in the Preface, nearly all the naturally occurring acetylenic compounds are acids or their derivatives. During the seventy years that have elapsed since Baeyer's first synthesis of indigo in 1881 from *o*-nitrophenylpropionic acid, there has been a slow realization of the importance of acetylenic compounds for the synthetic organic chemist, and it is only in the last decade, primarily as a result of the interest in the synthesis of vitamin A, that acetylene chemistry has been studied intensively. The main part of the present volume covers the literature up to the end of 1948, and the advances made in 1949 are summarized in an Appendix which cites 43 references.

The following misprints have been noticed: "nomenclature" broken up into two words on p. 2; $\text{HO}(\text{CH}_2)_n\text{NR}'_2$ printed as $\text{HO}(\text{CH})_{2n}\text{NR}'_2$ on p. 140; a missing letter in ref. 7 on p. 184; the formula of homoanthroxanic acid on p. 71. The formula of 2:2:3:3-tetrachlorohydrindone would look better with the single bond attached to Cl_2 omitted. The print is clear and pleasant to read, but different types of structural formulæ have been used for no apparent reason (see for instance p. 75 and p. 114). Both dots and lines are used, sometimes in the same formula, to represent linkages between atoms and groups.

The book is clearly written; the classification and arrangement of the subject-matter are logical and convenient for purposes of reference, although the thoroughness with which the literature has been surveyed in a little more than 300 pages has led to some sacrifice of readability. Information on any aspect of the extensive series of compounds and reactions connected with the acetylenic acids and references to the original literature can be obtained very readily from the book. Each topic has been minutely subdivided; the table of contents runs into 20 pages and there are about 1,500 references. For advanced students and research workers in organic chemistry, Dr. Johnson's two volumes on acetylenic compounds, together with Reppe's *Acetylene Chemistry* and Copenhagen and Bigelow's *Acetylene and Carbon Monoxide Chemistry*, are essential books which must be available in the departmental library.

K. V.

Organic Chemistry. By Louis F. Fieser and Mary Fieser. (D. C. Heath & Co., Borton), 1950. Pp. xv + 1,125. Price 42 sh.

The well-merited reputation, which this book made immediately after it was first published in 1944, will be further enhanced by this new second edition in which much fresh material has been added. The presentation of the subject-matter is well-balanced, logical and to the point. The fundamental principles have been developed in 27 chapters, the remaining chapters being devoted to specialised aspects without any loss of continuity. Due attention has been given to the significant advances made during the last few years in fundamental organic chemistry, biochemistry, chemotherapy, technology, etc. Consideration has also been paid to the physico-chemical aspects of organic chemistry, including reaction-mechanism, electronic theory and resonance. The newly added

chapter on Heterocyclic Compounds, including alkaloids and flavone pigments, has added to the quality of the book. The chapters dealing with carbohydrates, proteins, microbiological processes, metabolism of essential food materials, quinones, polynuclear hydrocarbons, synthetic plastics and resins, dyes, steroids and accessory dietary factors are particularly illuminating. The book is an excellent introduction to organic chemistry and will be useful both for graduate and post-graduate workers and also for those who want to keep abreast with modern developments in this particular branch of science.

S. C. B.

Oils, Fats and Fatty Foods: Their Practical Examination. By K. A. Williams. Third Edition. (J. & A. Churchill, Ltd., London), 1950. Pp. xi + 500. Price 63 sh.

No introduction is needed to this well-known practical book, the last edition of which was published 22 years ago under the authorship of Bolton. While many of the fundamental methods of analysis have since remained unchanged, new methods have also come into use and various officially-sponsored bodies all over the world have had under review during this period a number of standards for oils and fats. Dr. Williams, who is President of the International Commission for the Study of Fats and has been member of various standardising committees in the fields of oils and fatty foods, has brought out a most authoritative account of analytical methods, carefully chosen to represent modern practice. There are notes on the interpretation of the results obtained that would enable the investigator to arrive at satisfactory conclusions. Descriptions of the by-products of the edible oil industry are included as well as of a number of poisonous and medicinal oils, the latter chiefly with a view to facilitating their recognition if admixed with or substituted for edible oils. Tables for analytical limits are given for well over 200 oils and fats which include some not described in the earlier editions. Certain sections such as those on milk products and vitamins have been extended.

The reviewer would have desired a more detailed reference to the use and examination of anti-oxidants. Photo-electric methods for colour measurement could have been brought up to date by inclusion of instrument models with compensating photo-cell devices. Likewise, in referring to the conversion factor for deducing vitamin A content from determination of extinction coefficient at 328 $m\mu$, attention could have been drawn to the factor derived for crys-

talline vitamin A acetate and accepted as official by the A.A.O.C. The treatments under vitamins D, E and K are inadequate even for a volume of this kind.

The book, on the whole, is very well produced: one or two misprints such as 'begin' for 'being' (p. 24) scarcely merit mention. It should recommend itself as heartily as its predecessor.

A. SREENIVASAN.

Melting and Solidification of Fats. By Alton E. Bailey. (Interscience Publishers, Inc., New York), 1950. Pp. vii + 357. Price \$7.00.

Fats and fatty acids have been a fruitful material for investigation on account of their many characteristic properties amongst which their melting and solidifying behaviour stand out prominently. A study of these and of the interrelationship between different phenomena associated with phase transformations have brought out much experimental data. Such a study, probably, started more than a hundred years ago, although more accurate work on carefully purified materials has been done during the last twenty to thirty years only.

The book under review has put together all available data on this subject from rather widely scattered sources. It is divided into five chapters. The first is devoted to general and theoretical considerations in which structure of fatty molecules, intermolecular forces, and structure, properties, formation and dissolution of crystals have been discussed. Laboratory techniques of thermal methods, dilatometric methods and of control methods for determination of the phase transformations of pure substances as well as of commercial fats are given in the second chapter. In chapters three and four are assembled data on the crystal structure, polymorphism, melting and solidification points and latent heats of fatty acids and glycerides singly and in binary and ternary systems and of commercial fats. Solubility data are presented in chapter five. Chapter six discusses the flow properties of fats, factors influencing consistency, melting characteristics of some commercial edible and inedible fats and fractional crystallization.

The material covered by Chapters 3, 4 and 5 has already appeared to a large extent in the two excellent volumes on Fatty Acids—one by Markley and the other by Ralston. To that extent, it might appear repetition. However, as remarked by the author in his Preface, "the text has been written primarily for the practising oil and fat chemist or technologist. . . and it is believed that portions may be of interest to physical chemists at large". Important

features of the book are the critical correlation and interpretation of data and suggestions for further work.

The few printing errors noticed are *mn* for *mB* (p. 67, 8th line from bottom), *L* missing in Fig. 67, page No. 221 instead of 211 and 'sold' for 'solid' (p. 277, 8th line from bottom). The two lines of para 2, p. 276 should be corrected to read, "According to Ku¹¹ eleostearic acid is considerably less soluble in 76% ethyl alcohol than oleic acid. . .". These are no doubt minor errors. It is to be noted also that *A* has been used as the abbreviation of Angström instead of the usual *A* (pp. 16-17).

The book should be highly useful to oil chemists as well as to physical chemists interested in the subject of phase transformations.

J. G. KANE.

Multi-Enzyme Systems. By Malcolm Dixon. (Cambridge University Press), 1949. Pp. 100. Price 7 sh. 6 d.

Multi-Enzyme Systems by Malcolm Dixon is based on the lectures delivered by the author at the University College, London, in May 1948. Although the subject appears to be an unusual one, there is no doubt that it has a special interest in modern Biochemistry and related fields because of the light which the study of Multi-enzyme systems are beginning to throw on living matter. After a lucid introduction on enzyme and their properties, Dr. Dixon describes how enzymes can be coupled together functionally and some of the processes which such systems can bring about. The free energy liberated by one enzyme reaction, usually an oxidation, is transferred to another enzyme reaction, usually a synthesis, which requires it. There is no doubt that this kind of processes are of fundamental importance for cellular activity. It is essential for the continuity of cellular activity that a particular type of mechanism should be present for trapping some of the free energy of reactions, for storing it and for transferring it so that it can be utilized to the advantage of other vital processes. Thus, the coupled enzyme systems carry out two kinds of reactions, *viz.*, hydrogen-transfer reactions for generating energy and phosphate-transfer reactions for transferring and using it. In the last chapter the author describes the use of *rH* and *rP* scales for the evaluation of the energy data for these reactions. Although the author has presented lot of hitherto unpublished material, citation of the more relevant literature would have been a welcome addition to this interesting book.

P. R. VENKATARAMAN.

Wood Distillation and Its Products. By Baron A. Piret De Bihain & P. B. Padaki. Technical Monograph Series No. 1. (Technical Press Publications, Bombay). Price Re. 1.

The general principles of the process of wood distillation, including recovery of byproducts, have been briefly discussed in this 13-page monograph. The authors are associated with the wood distillation plant, installed at Londa in the Belgaum district of the Bombay Presidency. This plant, which is much smaller than the wood distillation plant at Bhadravati (Mysore), has a capacity to carbonize 80 tons of wood per day. In the bulletin a brief description of the carbonizing retort has been given, but no mention has been made of the scheme to be followed for recovery of the byproducts. The value of the bulletin would have been considerably enhanced, if the economic aspects of the wood distillation industry, particularly under Indian conditions, were discussed.

People interested in wood distillation will find a general review of the subject in this monograph.

S. K. N.

Lectures on Foundation Engineering. By A. E. Cumming. (*University of Illinois Bulletin*, Vol. 47, No. 35, Dec. 1949). Pp. 148. Price \$ 1.00.

The present Bulletin on foundation engineering is the outgrowth of lectures given by the author to his civil engineering students in 1941-42. The whole subject of foundation engineering has been explained in such a lucid manner that even persons with a very elementary knowledge of mechanics can easily understand the problems involved in the design of foundations. The treatment of the subjects of pile foundations and principal causes of settlement of structures are thorough. Every student aspiring to specialise in foundation engineering can with profit begin the study of the subject with this Bulletin.

It deals mainly with foundations for buildings.

Much water has flown since 1941-42. The proceedings of the Second International Conference on Soil Mechanics and Foundation Engineering and the recent books on the subject by Dr. Terzaghi, Casagrande and others give a measure of the rapid advance made since then in this comparatively new science. The theory of consolidation may be modified in the light of the present-day theories. The effect of earthquakes on foundations can also be mentioned briefly. In the design of foundations

mention has been made only of live and dead loads. In addition, shock loads or those causing vibrations in structures, especially those near the railway lines, will have to be taken into account. This is also necessary in case of important buildings which have to be proof against concussions caused by the falling of bombs. In certain situations, foundations will have to be designed not only to resist the weight of the superstructure but may also have to act as a retaining wall to resist earth pressures from sides. The design of such retaining walls which form part of foundation work has to be described briefly. On page 59, a mention has been made that piles are needed merely to compact a bed of loose sand so as to give it a greater density and a higher bearing capacity. The method by which this is done, specially by the method of enclosing the area by sheet piling all round, has to be described. This may render the use of batter piles unnecessary in many situations. The practice of driving holes close apart in loose soils and filling them up with sand to consolidate the soil in the case of light structures may also be mentioned. Description of the apparatus and the tests now made in soil mechanics laboratories for determining bearing capacity, settlement, shear and cohesive strengths, etc., can usefully form the subject-matter of another chapter.

The book is well got up with a number of photos and illustrations.

N. S. GOVINDA RAO.

Symposia of the Society for Experimental Biology. Number IV. Physiological Mechanisms in Animal Behaviour. Edited by J. F. Danielli and R. Brown. (Cambridge University Press), 1950. Pp. 482. Price 35 sh. net.

This number contains the papers read at a Symposium of the Society of Experimental Biology held at Cambridge in July 1949. In recent years almost every branch of physiology and biology has seen considerable expansion. The volume of scientific publications has increased to such an extent that even the specialist in limited fields, finds it difficult to cope up with the rapid developments in his own subject. The publication at frequent intervals of specialist surveys, such as those provided by the above symposium is, therefore, welcome. The twenty-one articles in this volume are authoritative and masterly contributions by well-known experts in their respective branches. The contributions cover advances in both experimental and theoretical fields.

The book has four sections. The first deals

with the range of capabilities of the sense organs of hearing, vision, proprioceptors, labyrinth and equilibrium. The second section deals with the central and peripheral control of behaviour patterns, the third with instincts, taxes, etc., and the fourth with learning. The book is a blend of physiology and psychology. Every psychological process has a physiological correlate and demands a physiological and psychological explanation. There is an interesting discussion on the dispute between vitalistic and mechanistic schools of behaviour study. Perhaps the United Nations may take note of the scientific approach to control the necessary outlets for certain endogenously generated drives, for instance aggression, and some knowledge of human innate releasing mechanisms, especially those activating aggression.

INDERJIT SINGH.

Wild Animals in Britain. By O. G. Pike. (Macmillan & Co., London), 1950. Pp. xii + 231. Price 18 sh.

It is rather unfortunate that man is not only distrusted by his own kin, but also by animals! *Per contra*, if a haven is created where the animals are left unmolested, either for reasons of sport or otherwise, the animals look up to him as a friend. Sanctuaries are, therefore, of national importance if we are to preserve our wild-life. Dr. Pike tells us that in his own garden sanctuary of two acres, he has induced mammals and birds to come and take food from his hands. There is a general feeling that animals in the protected areas multiply enormously and soon become a pest, but the fact is Nature always creeps in and restores the balance. Voles multiplied in great numbers in Scotland only when man had killed all the birds of prey and the wiesel which happened to be their checkmate.

In the book under notice, Dr. Pike has described the natural history of the British mammals, reptiles and amphibians. The descriptions are accurate and enlivened by anecdotes and references to classics. There are also a number of coloured plates and original photographs. An anecdote is worth quoting: when the author told some members of a hunt party of the cruelty in giving over to the hounds a fox that had hid in a chimney, he was told that the fox really enjoyed it! The climax came soon after when two innocent labourers were fined £10, because their dogs had chased and killed a rabbit before the dogs could be called back.

It would be interesting to find out what exactly the anal gland of the omnivorous badger secretes which is sucked by other badgers. The

pole cats emit a nauseating odour from their anal gland only if frightened, but the author tells us that if they are kept clean, the nauseating smell usually associated with them becomes a fallacy. Still enigmatic is the way in which a dormouse by making a tiny hole in a nut clears the contents of it.

There are two indexes and the get-up of the book is excellent. However, I noticed one error in the shape of an additional punctuation mark in the penultimate line of the last but one para on page 212.

The book is so full of information that it is recommended to every student of natural history. May the reviewer express the hope that an equally authentic and comprehensive book as this will soon be compiled about Indian mammals, if not about all the vertebrates?

L. S. R.

Botany—A Text Book for Colleges. By J. B. Hill, L. O. Overholts and H. W. Popp. Second Edition. (McGraw Hill Book Co., N.Y. & London), 1950. Pp. xvi + 710. 335 Figs. Price \$5.27.

The contents of this delightful book comprise of materials intended for a two semester college course. The first part dealing with the structure and physiology of seed plants begins with a general introduction followed by a chapter on plant pigments, a striking feature of plants usually neglected in text-books. In the other ten chapters treatment of the subject does not differ much from the general plan followed in majority of text-books. Separate chapters have been given to seeds and seedlings, metabolism—food synthesis; growth and movement; metabolism—catabolic phase—digestion, respiration, fermentation. The second part, in six chapters, deals with plant groups, classification, nomenclature and families of angiosperms. Bacteria, slime, molds and fungi are grouped under thallophyta. A chapter on heredity is added at the end.

Many items of practical interest not usually found in general text-books of botany are briefly included. For example, accounts of viability, longevity and dormancy of seeds; factors affecting growth (heredity, nutritional balance, growth substances, vitamins, hormones, correlation of plant parts, grand period of growth); viruses, economic importance of fungi—penicillin and its uses; medical mycology; plant diseases, plant pathology and control are found. A newer system of classification (based on Prof. Tippo) has been given and for comparison the older system is presented on the opposite face.

The presentation is nondogmatic, simple and clear; yet as a previous reviewer has stated, this book is no child's play. The book would be welcomed by all students and should find a place in every teaching college.

N. K. S.

Wheat in a Victorian Bulk Depot. Bull No. 244. C.S.I.R.O. Australia, 1949.

This Bulletin is an interesting and accurate record of changes occurring in a very large mass of bulked wheat stored over nearly three years. Usually, this type of work is attempted with comparatively small lots of grains, the inferences drawn from such observations being applied, *ipso facto*, to bulk quantities, without much justification. Here, the author has made effective use of the unique opportunity afforded to him of working on probably one of the world's biggest single heaps of wheat occupying 1,72,260 sq. feet of floor space and holding more than 90,000 tons! Into this prodigious mass he has dug and delved, with meticulous care and precision, making observations about changes in temperature, moisture content, insect-infection, loss of weight and other relevant data at definite sampling-points and at regular intervals, from the time the mound was built up, till it was all moved out,—which was nearly three years. The author deserves to be complimented on this compilation, in which he has presented the results of three years' untiring labours which act as a guide to workers outside Australia.

The terse description of Marmalake No. 1 depot (pp. 7-8) might, however, have been accompanied by a sketch to help the readers in other countries understand the "arrangements" better. Moisture content determinations stated to have been made after a considerable interval after taking the samples (p. 20) are admittedly defective as stated by the author himself (p. 22) though this is greatly mitigated by probably treating all samples alike in this regard. The section on "Insect infestation" is slightly confusing even to the careful reader, and the figures do not really help to dispel this confusion.

These minor defects notwithstanding, this monograph is a valuable contribution to the literature on grain-storage. Especially in our country where a shortage of foodgrains to meet current requirements is causing anxiety, the observations recorded in this Bulletin will be very useful in planning for safe storage of large reserve stocks of grains, proposals for which are being considered by Government.

D. SESHAGIRI RAO.

SCIENCE NOTES AND NEWS

Plasticine as Embedding Material for Making Free-hand Sections

Sri. P. J. Dubash, Botany Department, Royal Institute of Science, Bombay, writes as follows:

It has been the practice so far to embed leaf material in pith, pieces of carrots, etc., prior to taking free-hand sections. This method, though universally adopted, has the following drawbacks: (1) The material keeps moving inside the pith with every stroke of the razor; this results in oblique sections. (2) The pith in itself is hard to section and more often than not, it is harder than the material to be sectioned. (3) It thus becomes very difficult to obtain sections, particularly, of preserved material which is generally very soft.

It has been my experience that by embedding the sectioning matter in plasticine all these disadvantages are obviated. Not only that but it is possible to obtain very thin sections. The shavings of plasticine could then be collected and used again *ad infinitum*.

This method, it is hoped, will be of some use both to the undergraduates and the research students alike.

Child Welfare Films

The "International Index of Films and Filmstrips on Health and Welfare of Children", contains some 1,000 titles from 26 different countries. It includes films made for the general public, health education shorts for children themselves, and medical and other technical films for professional personnel. For each film, information is included concerning the content, length, and approximate date of production as well as the full address of the distribution source or producer.

All films are listed in the catalogue under their countries of origin, and indexed by subject classifications. The subject index includes sections on growth and development, nursery schools, child psychology, diseases and their control, education, holidays, safety, maladjusted children, welfare, nursing, medical and scientific subjects, nutrition and public health.

The films have not been evaluated by either UNESCO or WHO, but it is hoped that the information given is full enough to indicate the relative value and usefulness of the various films.

—By courtesy of "WHO Newsletter".

IXth International Congress of Entomology
The IXth International Congress of Entomology

will be held between August 17th to 24th, 1951, in Amsterdam (Netherlands). Entomologists wishing to receive in due course programmes and application forms are requested to communicate even now with the Secretariat, C/o Physiologisch Laboratorium, 136 Rapenburgerstraat, Amsterdam.

Further communications will follow soon.

Seventh International Botanical Congress—

The Seventh International Botanical Congress met in Stockholm, July 12-20th, 1950, under the presidency of Prof. C. Skottsberg, Director, Emeritus, of the Goteborg Botanical Garden. Nearly fourteen hundred plant scientists, from all corners of the world, attended the Congress.

There were 15 special sessions: (1) Agronomic Botany; (2) Cytology; (3) Experimental Ecology; (4) Experimental Taxonomy; (5) Forest Botany; (6) Genetics; (7) Morphology and Anatomy; (8) Mycology and Bacteriology; (9) Nomenclature; (10) Palaeobotany; (11) Phytogeography (with Comparative Ecology); (12) Phytopathology; (13) Plant Physiology; (14) Taxonomy of Cryptogams; (15) Taxonomy of Phanerogams.

Mention should be made of the Palynological Conference in Bromma, organized by G. Erdtman, the meetings which led to the establishment of an International Association for Plant Taxonomy and Geography (Sec.: J. Lanjouw), a round table conference on urgent needs in cryptogamic botany, the special sessions arranged for, at the last moment, in order to give the Russian delegates an opportunity to present their scientific (and political) views, and the meetings of the International Union of Biological Sciences prior to the Congress in the building of the Swedish Academy of Sciences.

I.C.A.R. Aid to Current Science

We wish to tender grateful thanks to the Indian Council of Agricultural Research for the generous subvention of Rs. 500 for 1949-50 towards the publication cost of *Current Science*. This annual grant which *Current Science* has been receiving since 1940 has contributed substantially towards the maintenance of the Journal.

EDITOR.

Vol. 19, No. 10, page 309, column 2: Note on "Suppression of High Frequencies in the Production of Joshi Effect"; delete line 3 from the bottom.

B.D.H.

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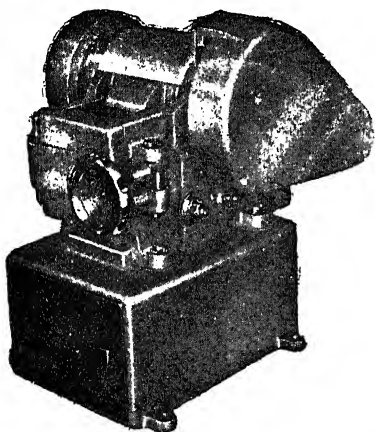
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Current Science

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DECEMBER 1950

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THE LUMINESCENCE OF DIAMOND—I

SIR C. V. RAMAN

1. INTRODUCTION

NO less than seventy-five distinct papers which concerned themselves with the structure and properties of diamond were communicated by the present writer and his collaborators and published in the *Proceedings* of the Indian Academy of Sciences between the years 1934 and 1948. Review articles surveying the work of the latter part of this period appeared from time to time in the pages of *Current Science*. Investigations on the diamond have once again been taken up and fresh results have been reported in the *Proceedings* of the Academy for August 1950.* It appears appropriate in these

circumstances to give an account of this recent work in the light of the earlier investigations. In doing so, we shall not trouble to quote literature references, since the interested reader will find a complete bibliography classified under various headings on pages 269 to 287 of the *Proceedings* of the Academy for December 1948.

When the phenomenon of the luminescence of diamond first came under the notice of the present writer in the year 1930, it was not regarded as a subject offering scope for research. Actually, it presented itself as an impediment to the researches then in progress which had for their object the spectroscopic study of the scattering of light in diamond with a view to discover the nature of the *complete vibration spectrum* of that substance. The realisation of

* *Memoirs of the Raman Research Institute*, No. 9. "The Luminescence of Diamond and its Relation to Crystal Structure," by Sir C. V. Raman and A. Jayaraman.

this aim had indeed to wait for many years until some non-luminescent diamonds came into the possession of the writer. That the luminescence was itself a phenomenon worthy of study did not suggest itself till the year 1940 when Mr. P. G. N. Nayar took up the problem at the instigation of the writer. It soon became apparent that a most fertile field of research awaited exploration.

luminescence of diamond, namely, the enormous variations in its intensity.

The first of the six pictures in the figure shows a group of 88 South African diamonds set within a circlet of pearls as seen by daylight. The remaining five pictures show the same diamonds made visible by their emission when irradiated by sunlight filtered through a plate of nickel-oxide glass. The five pictures

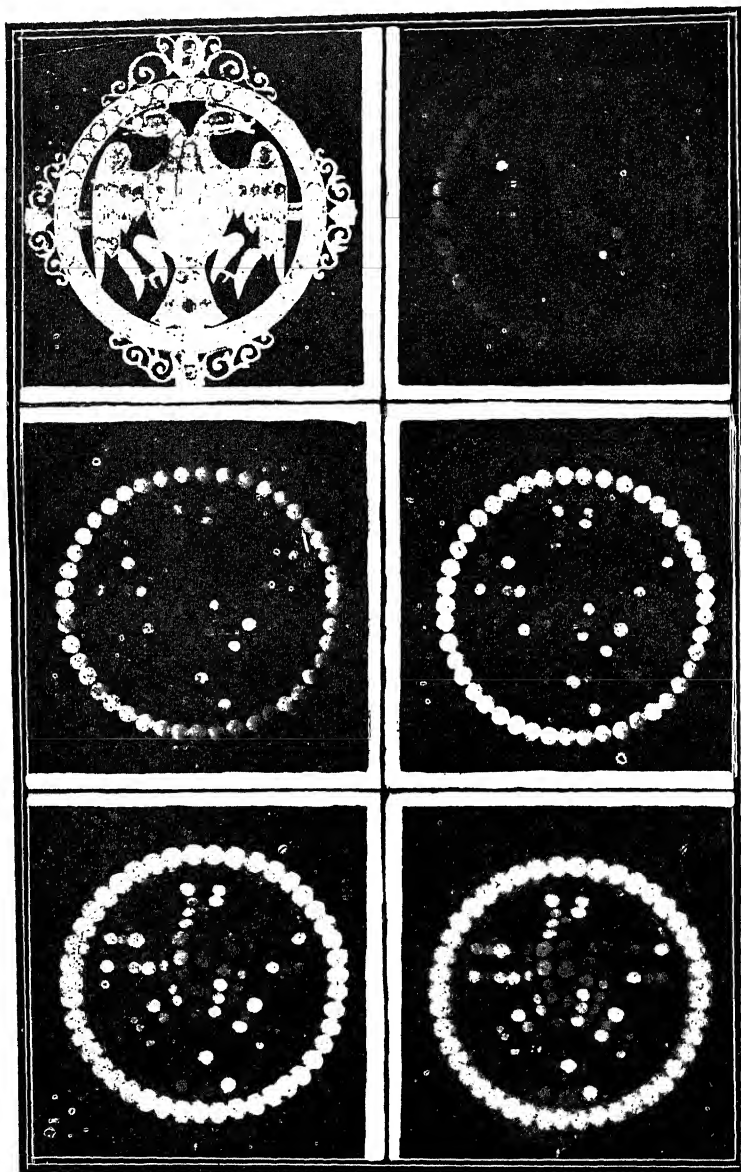


FIG. 1

Luminescence of South African diamonds

The photographs reproduced in Fig. 1 exhibit one of the remarkable features of the luminescence of diamond, namely, the enormous variations in its intensity. The five pictures were recorded respectively with exposures of 5 seconds, 15 seconds, 30 seconds, 120 seconds and

1,800 seconds. Only in the last and most heavily exposed picture is it possible to recognise the original pattern seen by daylight.

Equally noteworthy are the variations in the colour of the luminescence of diamond. While the majority of clear white diamonds show a blue luminescence, others exhibit a greenish-blue, green or greenish-yellow luminescence under ultra-violet irradiation, while a small minority are definitely non-luminescent. In June 1942, the writer had the opportunity of examining a great many diamonds of Indian origin at Panna, and was much impressed by the fact that all the 52 diamonds of the highest quality and of great size in the necklace owned by the Maharaja of Panna were blue-luminescent, though the intensity of such luminescence varied largely. During a visit by the present writer to London in May 1948, the opportunity

in cages in the order of their excellence as judged by their water and freedom from colour. Each cage contained some fifty to sixty crystals. All the diamonds without exception from the first six cages showed a luminescence of blue colour. Examples of green or yellow luminescence were very few even in the cages containing the lower grades, a blue or bluish-green luminescence being by far the commonest effect observed. The similarity between these results and those observed with the Panna diamonds in June 1942 was so striking that one could scarcely doubt that the blue luminescence was a characteristic property of diamond of the first quality.

2. LUMINESCENCE AND ABSORPTION SPECTRA

Examination of the spectrum of the light emitted by luminescent diamonds reveals the

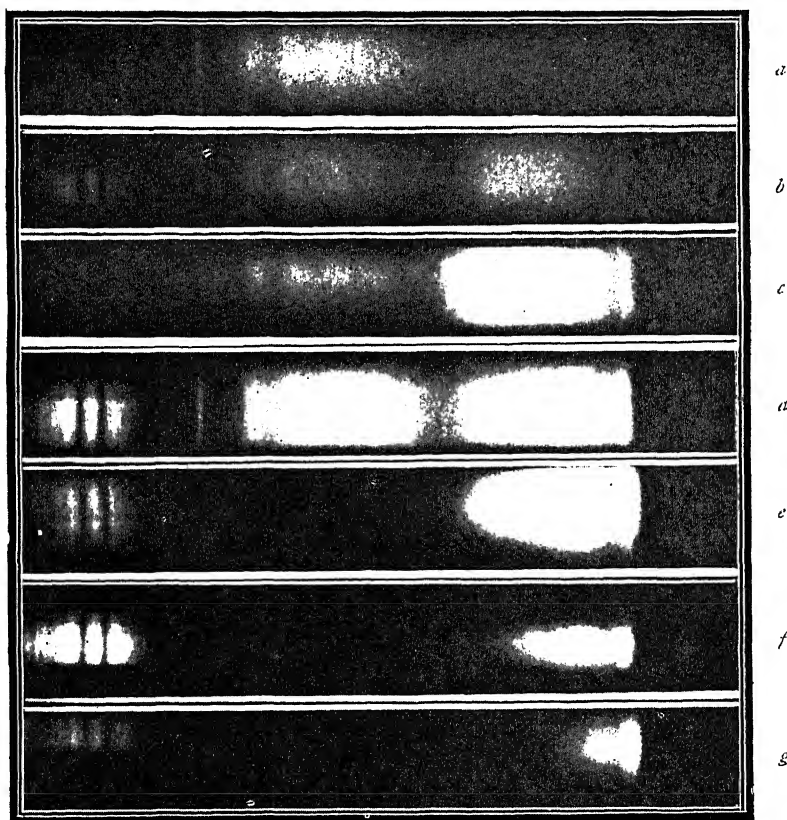


FIG. 2

Luminescence spectra of diamonds

(a) Blue. (b) Bluish green, (c) Green, (d) Bluish white, (e) Greenish yellow, (f) Yellow, (g) Orange.

arose of examining the luminescence of a very large number of diamonds of high grade from the Congo area in their natural form as crystals. The stones had been sorted and arranged

cause of the variations in its colour. In Fig. 2 are reproduced a set of seven pictures recorded in some recent studies by Mr. A. Jayaraman. The first of these pictures is that of a typical

blue-luminescent diamond, while the third spectrum is that of a diamond exhibiting an intense green luminescence. These types of emission were those very thoroughly studied by Mr. P. G. N. Nayar and Miss Anna Mani respectively. It is evident that the second and fourth spectra in the figure are superpositions in different intensity ratios of the blue and green types of luminescence. The last three spectra in the figure represent other types of luminescence which are less common but are also of great interest. It would seem that they arise from a progressive extinction of the shorter wave-lengths in the second or green type of spectrum with a consequent approach of the colour of the luminescence to a pure yellow or orange.

The spectra reproduced in Fig. 2 were recorded with the diamonds held at room temperatures. Lowering the temperature of the crystal to that of liquid air results in the sharpening of the bands, whereby the true character of the spectra stands clearly revealed. Lowering of the temperature has an analogous effect on the corresponding absorption spectra

Nayar and Anna Mani. In Fig. 3, the upper of the two spectrograms represents the emission spectrum and the lower the absorption spectrum. The former exhibits the bright lines at $\lambda 4152$ and $\lambda 5032$ characteristic of the blue and green types of luminescence respectively. The lower spectrum, on the other hand, exhibits dark lines in absorption at the same wave-lengths. It will be seen from the same figure that the emissions at $\lambda 4152$ and $\lambda 5032$ are accompanied by subsidiary bands towards the longer wave-lengths. In absorption, on the other hand, the subsidiary bands appear towards shorter wave-lengths. The subsidiary bands in emission and absorption exhibit mirror image symmetry about $\lambda 4152$ and $\lambda 5032$ as the case may be, their frequency shifts with respect to these being equal and opposite. This is clearly seen from Fig. 4 in the case of $\lambda 5032$ and from Fig. 5 in the case of $\lambda 4152$. In the latter figure, the absorption spectrum has been reversed so as to exhibit the mirror image symmetry about $\lambda 4152$ line by the coincidence of the dark bands in absorption with the bright bands in emission.

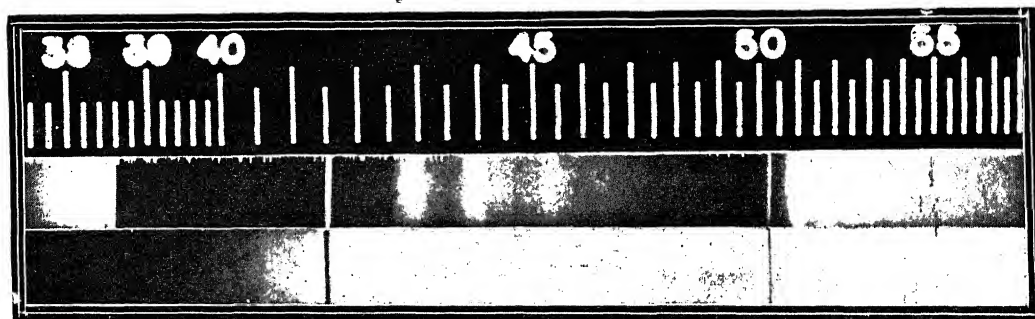


FIG. 3

The fluorescence and absorption spectra of diamond.

exhibited by the same diamond. Inter-comparison of the emission and absorption by the same diamond at low temperatures reveals the re-

The relationship between the emission and absorption spectra of diamond is also illustrated in a striking manner by studying the effect on

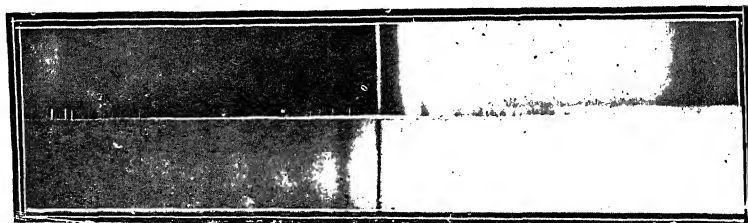


FIG. 4

The 5032 system in emission and absorption at liquid air temperature showing mirror image symmetry markable connections between the two. These features are apparent from Figs. 3, 4 and 5 the intensity of the luminescence of exciting the same with monochromatic light the wave-length reproduced from the papers of Mr. P. G. N. of which can be altered. Anna Mani carried

out a series of experiments of this kind and found that the intensity of the blue luminescence passes through a series of maxima and minima when the exciting radiation is on the short wave-length side of $\lambda 4152$ and is gradually shifted towards that wave-length. It reaches a large maximum when the exciting band coincides with $\lambda 4152$ and then drops suddenly to a small value when shifted to greater wave-lengths. Similar effects in respect of the green luminescence are noticed when the exciting radiation lies on one side or the other of the principal absorption at $\lambda 5032$ which goes hand

3. THE LATTICE SPECTRUM OF DIAMOND

The foregoing interpretation of the observed facts finds confirmation in the agreement of the frequency differences (positive and negative respectively) derived from the luminescence and absorption spectra with the lattice frequencies in diamond as determined from studies on the scattering of light and on the infra-red absorption in the substance. The electronic absorption and emission lines are diffuse at room temperatures and exhibit a readily observable width and structure when it is cooled down

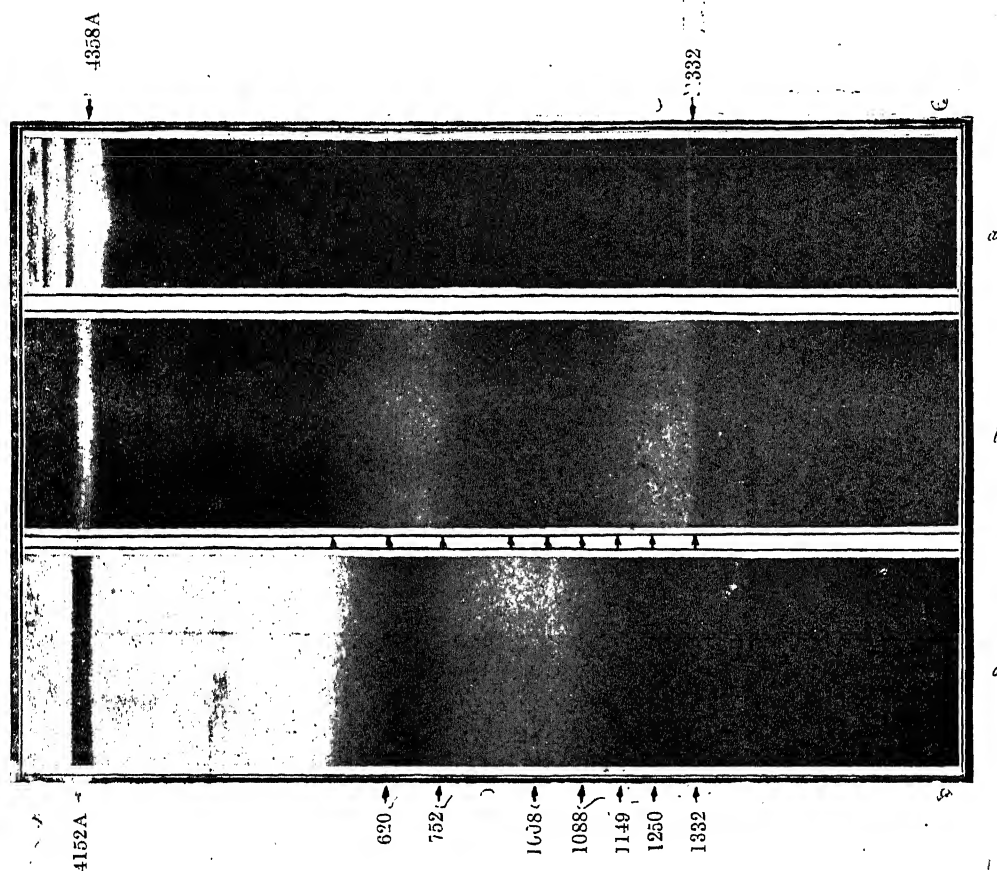


FIG. 5

(a) Raman spectrum of diamond. (b) Emission spectrum and (c) Absorption spectrum (reversed)

in hand with that luminescence. The facts recited show that the absorption and emission centred at $\lambda 4152$ and $\lambda 5032$ respectively represent electronic transitions, while the subsidiary bands represent the vibrational transitions of the crystal lattice which are coupled with these electronic transitions.

to liquid air temperature. This introduces some uncertainties in the lattice frequencies as deduced from the studies on luminescence or the corresponding absorption. Such uncertainties are even greater in the case of the green luminescence, the $\lambda 5032$ line being diffuse even at

liquid air temperature. Nevertheless, the results are sufficiently definite to give us an indication of the nature of the vibration spectrum of the diamond lattice. Particularly remarkable is the appearance in the emission spectrum of blue luminescence, of a series of well-defined

is evident from the accompanying microphotometer record. As already remarked, the finite width of the $\lambda 4152$ line sets a limit to the sharpness with which the vibrational transitions are recorded. The sharpness is even less satisfactory in the case of the $\lambda 5032$ line and the

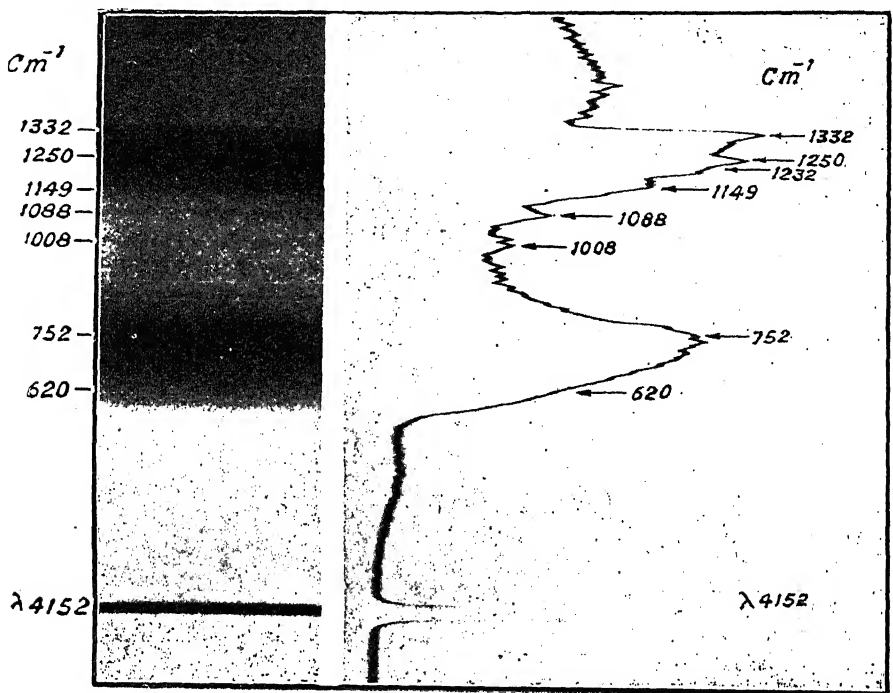


FIG. 6
The emission spectrum of blue-luminescent diamond

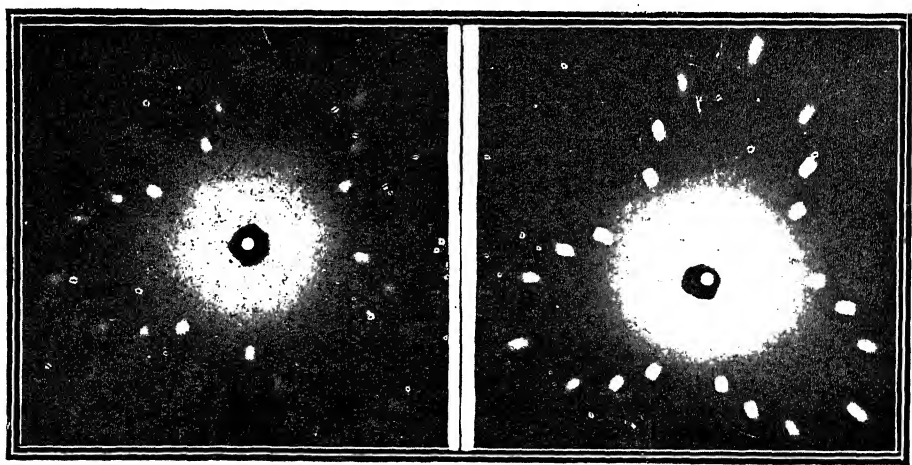


FIG. 7
Laue photographs of two blue-fluorescent diamonds

bands. These are shown in Fig. 6 taken from a paper by K. G. Ramanathan. Their positions are marked in the figure and their sharpness

accompanying vibrational transitions. Hence, the evidence from the luminescence spectra regarding the discrete character of the lattice

vibration spectrum of diamond must be regarded as indicative rather than as demonstrative. The real proof of the discrete line-character of the lattice vibration spectrum of diamond comes from the studies on light scattering, where the sharpness of the recorded lines is determined by the monochromatism of the incident light which is very high.

The spectroscopic facts set forth above make it clear that in spite of the enormous variations in the intensity and colour of the luminescence of diamond, we are dealing with a well-defined phenomenon namely, certain electronic transitions and associated vibrational transitions, the positions of which do not vary either with the particular specimen or with the locality of its origin. What varies is the intensity of these transitions. Thus, we are naturally led to infer that the luminescence is a phenomenon characteristic of the diamond itself, and that the variations observed arise from corresponding variations in the fine structure of the crystal. This conclusion is powerfully reinforced by

X-ray studies especially those made and reported in various papers by Dr. G. N. Ramachandran. It is found that there is a precise quantitative correlation between the strength of the blue luminescence exhibited by diamonds with the intensity of the X-ray reflections, both of the Laue and the Bragg types, given by their crystal planes. This is illustrated for the Laue reflections in Fig. 7. The two photographs reproduced were recorded with equal exposure, with two diamonds of equal thickness but differing in the intensities of their blue luminescence. It is seen that the Laue reflections of the two diamonds differ greatly in their intensity. Dr. G. N. Ramachandran has also shown that the angular divergence of the Bragg reflection given by the diamond with monochromatic X-rays is least for faintly blue-luminescent diamonds and increases with the intensity of that type of luminescence. In other words, the former represent the nearest approach to an ideally perfect crystal structure.

(To be continued)

MEMORIAL TO LORD RUTHERFORD

THE Council of the Royal Society have issued an appeal for financial support for the creation of a suitable memorial to the late Lord Rutherford of Nelson.

It is universally acknowledged that Lord Rutherford was one of the foremost figures in twentieth century science. Our present knowledge of the structure of the atom is, to a very large extent, due to the researches carried out under his inspiring leadership. Together with Soddy, he put forward the conceptions of radioactive series and of isotopes. His classical experiments on the scattering of α -particles led to the nuclear model of the atom. This spurred on Bohr, then working with Rutherford, to formulate his picture of the atom as being composed of stationary quantum states. The first artificial transmutation was observed by Rutherford by bombarding nitrogen nuclei with α -particles. This technique, applied to other light elements in various laboratories of the world, finally culminated in the discovery of the neutron by Chadwick in Rutherford's own laboratory.

It was again under Rutherford's direction that Cockcroft and Walton achieved the first atomic transmutation by means of artificially accelerated particles. This experiment not only opened up a new method of disintegrating atoms, but also served to demonstrate the validity of Einstein's mass-energy relation and to point out the possibility of the transformation of matter into energy. Feather, working with Rutherford, was the first

to show that neutrons could produce nuclear transmutations, an observation, which in the hands of Fermi and collaborators in Rome, and Hahn and others in Berlin, led to the discovery of nuclear fission. The further development of this resulting in the release of "atomic energy" is recent history. We do not yet know the full potentialities of this newly discovered source of energy, which, if harnessed for the good of humanity, may perhaps usher in a new era in civilisation.

It is proposed that the memorial should take two forms:

1. Rutherford Scholarships, tenable for three years to be awarded to post-graduate students within the Commonwealth, for research in natural sciences with a preference for Experimental Physics, the scholar to carry out his research in an Institution in some part of the Commonwealth other than that in which he graduated.
2. A Rutherford Memorial Lecture to be delivered at intervals at selected centres in the Commonwealth, at least one in three to be given in New Zealand, where Rutherford was born.

Since a substantial endowment fund will be needed for these purposes, the Royal Society have sent out an appeal for contributions to the fund and we heartily endorse this appeal. Contributions may be sent to the Rutherford Memorial Committee, The Royal Society, Burlington House, London W. 1, England.

EDITOR.

HORA'S SATPURA HYPOTHESIS¹

An Aspect of Indian Biogeography

IT is fortunate that within a few months of each other, two important contributions² on biogeography, independently conceived and executed in each case by a team of scientists, have been published recently, enabling one to check his results against the findings of the other group of workers. One published in September 1949 in the U.S.A. deals with "Biogeography of the Pleistocene" by Dr. Edward S. Deevey, Jr. of the Yale University. This is one of the 12 contributions on "Pleistocene Research" and deals mostly with the problems of Europe and North America. The second contribution is more restricted in its scope, but the "Symposium on the Satpura Hypothesis of the Distribution of Malayan Fauna and Flora to Peninsular India", published at Calcutta in November-December 1949, contains a series of 21 articles.

Dr. Deevey points out that "from the standpoint of Pleistocene biogeography, North America and Europe resemble each other closely, and differ in the character of their problems rather sharply from Africa, Southeastern Asia, and South America" (p. 1404). Though admittedly the characters of the problems in the two vast regions are different, the fundamental scientific approach for elucidating these problems appears to be the same in both cases. For instance, in both the contributions, attention has been paid not only to the present-day distribution of animals but also to geology, stratigraphy, climatology and glaciology in so far as they have influenced the pattern of distribution in the past ages. In this review of the two contributions, it is intended to apply some of the principles enunciated in the Symposium on "Pleistocene Research" to the findings contained in the Symposium on the "Satpura Hypothesis".

CERTAIN VIEWS SET FORTH IN THE
"PLEISTOCENE RESEARCH" SYMPOSIUM

Effects of Glaciation.—Considering the problems of North America and Europe, Deevey stated (p. 1404):

1. This review was sent to Professor F. E. Zeuner for comments and suggestions. His observations are given in the body of the paper in brackets or as foot notes. The reviewer is grateful to him for his kindness and courtesy.

2. "Pleistocene Research," *Bull. Geol. Soc. America*, Sept. 1949, 10, No. 9, 1305-1525.

"Satpura Hypothesis," *Proc. Nat. Inst. Sci. India*, Nov.-Dec. 1949, 15, No. 8, 309-422.

"As would be expected, the two continents where continental glaciation occurred on the most extensive scale differ from the rest of the world where glaciation was confined to high mountains, and where the more spectacular climatic changes during the pleistocene were in the direction of increased precipitation rather than refrigeration".

In dealing with "Problems of Pleistocene Stratigraphy" and in this connection with the "stratigraphy of areas remote from and only indirectly associated with Glaciation", Ray¹ (p. 1469) observed:

"In areas far from glaciated regions where there are no direct means of correlating events with ice advances and recessions, the problems of Pleistocene stratigraphy are manifold and difficult. Their solution must be based ultimately on climatic fluctuations which in these areas were generally not so large nor so important an environmental factor as in glaciated areas or the areas peripheral to glaciers. These climatic fluctuations appear to have produced either intensified or lessened precipitation along with temperature changes. Cool-moist periods are generally correlated with glacial ages, warm-dry with interglacial".

Other observations bearing on the Satpura Hypothesis.—Beside the effect of glaciation in areas remote from it, there are five other considerations which must also be borne in mind in evaluating the Satpura Hypothesis. These are as follows:—

(i) It is generally recognised that there was a sequence of four major glacial ages, separated by interglacial ages as warm or warmer than the present.

(The major glaciations separated by interglacials relate to what is today the temperate zones of the northern hemisphere. This rhythm has not been firmly established yet anywhere else. F. E. Zeuner).

(ii) In Pleistocene stratigraphical work, it is generally assumed that climatic fluctuations were broadly synchronous throughout the world.

(You rightly say that it is assumed that climatic fluctuations were broadly synchronous throughout the world. It is important to remember that this is an

1. Ray, L. L., "Problems of Pleistocene Stratigraphy," *Bull. Geol. Soc. America*, 1949, 60, 1463-74.

assumption and that it has never been proved. This refers in particular to glaciations in the northern and southern hemispheres respectively. Personally I think that it is more likely than not that they were synchronous, but we must be honest and admit that it has not been proved, in spite of all the sweeping statements to this effect. *F. E. Zeuner*).

- (iii) Climatic fluctuations during the Pleistocene caused fluctuations of sea level in response to the amount of water withdrawn from the oceans and temporarily held in glaciers on the land.
- (iv) Besides the normal crustal movements throughout the world, crustal warping and rebound in glaciated and peripheral regions, occasioned by the loading and unloading of the crust with ice, also occurred.
- (v) Relict floras and faunas generally indicate that the present-day climatic conditions of their habitats are more or less similar to those prevailing in the past ages in those specified areas.

Ecological Specificity of Animals: Biological and Physical Environment.—Besides the above considerations, it is essential in biogeographical studies "to evaluate qualitatively the importance of the adaptations to environmental changes produced through climatic fluctuations, it is essential to know, (1) the magnitude of these fluctuations necessary to change the environment significantly, and (2) the relative sensitivity of fauna, flora, soil, erosive processes, and other factors to these changes. Until more is known of the relative sensitivity of the various indicators of climatic fluctuations, interpretation of the past can be only subjective". (Ray, p. 1470).

It is true, as pointed out by Ray (p. 1469) that "changes in floral assemblages will be correlative with faunal changes", and that "commonly migrations in altitude of the fauna is the only indication of climatic change unless extinction of the species is known". (Ray, p. 1470). It would thus appear that "all life, the environment, and the attendant physical processes were influenced by the sequence of climatic fluctuations on which Pleistocene stratigraphy ultimately must be based" (Ray, p. 1471).

Smith¹ (p. 1486), in dealing with the effects of Pleistocene climatic changes, has remarked: "Climatic effects in nonglaciated areas are recorded in two main types of phenomena:

biologic and physical. Investigations of the biologic phenomena, involving the migration and progressive modification of floras and faunas, are fundamental and are dealt with elsewhere in this series of papers. The evidence provided by purely physical phenomena complements the biologic record and, in many places where fossils are absent or inadequate, provides the primary basis for interpretation of former climatic changes. Of the various physical effects related to climatic fluctuations, three are of particular interest for the problems which they present and for their significance in the interpretation of the Pleistocene record: (1) eolian phenomena, including dune building, loess deposition, and sand blasting; (2) frost phenomena, including mechanical weathering, ground-ice development, solifluction, and associated processes; and (3) stream terracing produced by alterations between aggradation and degradation".

Deevey's fundamental conceptions and principles.—In his valuable contribution, Deevey has referred to certain biological deductions and principles which are well worth reiteration. These are:

1. Species spread much or little according, first, to their inherent abilities to disperse, and second, to the intensity of the geographic barriers opposing them.
2. Existing ranges of species and of larger groups are the product not of existing geographic conditions, but of all geographic conditions obtaining throughout the history of the species or stock. It is fallacious therefore, to assume that the existing distribution pattern of the species is as old as the species itself, or as the genus or family to which it belongs. It is true, however, that in the case of species that arose in the pre-Pleistocene period, during the Pleistocene "there has been sufficient time, and sufficient transfiguration of geography, for the pre-Pleistocene distribution pattern to be completely transformed in a very large number of cases".
3. Pleistocene biogeographical studies are bipolar. "At one pole are grouped ecology, systematic botany and zoology, the study of evolution, and related biologic disciplines. At the other pole are grouped the Earth sciences, all of which are concerned in understanding the geography of the Pleistocene". Pleistocene research is,

1. Smith, H. T. U., "Physical effects of Pleistocene climatic changes in non-glaciated areas: eolian phenomena, frost action, and stream terracing," *Bull. Geol. Soc. America*, 1949, 60, 1485-1515.

however, one integrated subject, pursued in equal partnership by biologists and geologists in the widest sense.

4. "A few kinds of animals, and perhaps a few plants really seem to require continuous land connection for their dispersal, and it is impossible to imagine their crossing a water gap".
5. Recolonization is not so much a matter of accident as of ecological succession. As soon as living conditions are suitable for the survival of an animal species, that species appears.

In order to explain his fundamental position on matters of biogeography, Deevey has set forth the following guiding principles:—

1. Biogeography should deal with species, not with families or orders.¹
2. The age of a distribution pattern is not necessarily the same as the age of a species.
3. All distributions of species are taken to be of Pleistocene date in the absence of a good proof that they are older.²
4. The present range of the parent species is not necessarily the place of origin of the off-spring species.
5. Modern genetic and ecologic theories are in full agreement that species do not arise from other species except through reproductive isolation of segments of a parental population, and that in sexually reproducing animals and plants the reproductive isolation is ordinarily achieved through geographic segregation. . . . Nearly all well-studied cases of sub-speciation and speciation point to the Pleistocene as the time of such previous isolation, and the

1. This is undoubtedly an over-generalisation. What the author really means is that we should work with as detailed information as possible and therefore descend to the species and sub-species level wherever possible. This is a matter-of-course for every serious worker and has always been so in biogeography. On the other hand, there are problems which are peculiar to the higher systematic units. As an example, the distribution of palms or of reef-building corals can, and ought to be, considered on the level of families or orders.—F. E. Zeuner.

2. This is a very narrow outlook indeed, borne from the consideration of glaciated and periglacial areas. In other parts of the world it would be foolish to make any such dogmatic assumption and in recent years much evidence has been accumulating indicating that both species themselves and distribution patterns in some countries are often very much older than the Pleistocene.—F. E. Zeuner.

occurrence of closely related forms in the same area is therefore attributed to post-Pleistocene alterations in geography and in biogeography.

APPLICATION OF THE ABOVE CONSIDERATIONS TO THE SATPURA HYPOTHESIS

Distribution and Ecology of the Present-day Fauna and Flora.—Of the 21 papers, included in the Symposium on the Satpura Hypothesis, as many as 10 papers deal with the distribution of animals (Mammals, Birds, Chelonians, Snakes, Lizards, Fishes and Annelids) and 2 with plants (Paresnath Hill and Bailadila Range). The authors of these papers, dealing with races, sub-species, species and genera, have conclusively established that—

- (i) There is a considerable element of the so-called Malayan fauna and flora in the Peninsula of India and Ceylon.
- (ii) The route of migration of this element lay across the Garo-Rajmahal Gap (from the Assam Hills and Eastern Himalayas on the one hand and the Plateau of Chota Nagpur on the other).
- (iii) From the Chota Nagpur Plateau, there are possibilities of two routes of migrations — Vindhya-Satpura-Western Ghats route and Orissa Hills—Eastern Ghats-Western Ghats route.
- (iv) The specialized flora and fauna are adapted to an evergreen biotope with considerable annual rainfall, about 100 inches or so, spread over a greater part of the year.
- (v) Altitudinal distribution of plants and animals is not so much governed by temperature as by annual precipitation and relative humidity throughout the year.
- (vi) The present-day distribution patterns of various species are governed by ecological considerations and along the routes, wherever and whenever suitable habitats have been investigated, fresh evidence of such migrations has been established.
- (vii) In the case of birds and fishes, it has been opined that the present element in the hills of Peninsular India, is the result of more than one wave of migration.
- (viii) The compositions and inter-relationships of the floras and faunas indicate that migrations of terrestrial forms occurred mostly during the Pleistocene, whereas the dispersal of the

aquatic forms has been going on from much earlier periods.

Climatology.—The two articles dealing with climates have also emphasized the ecological specificity of the fauna and flora being mostly responsible for their dispersal in the past and the present-day distribution pattern. It has also been concluded that during the pluvial periods increased precipitation produced favourable conditions for the dispersal of plants which later contributed to the dispersal of land animals. During the arid or inter-glacial periods, the floras and faunas became restricted to certain suitable areas and thus isolated in patches. This inhibited inter-breeding of isolated stocks, thereby causing speciation. Sometimes the species, thus isolated, had sufficient time to be differentiated and thereby escaped being swamped over by the succeeding waves of migrations while in slow-evolving forms any such differentiation may have been swamped over by the next wave thereby causing reversion to the ancestral stock. The indications of such happenings are many though they have not yet been intensively studied and properly elucidated.

Geological Considerations.—Auden, on p. 337 of his article entitled "A Geological Discussion on the Satpura Hypothesis and Garo-Rajmahal Gap", gives the following as the primary factors involved in the faunal migration:—

- "(1) A secular climatic change, involving 4. or 5 glaciations, with interglacial periods which were probably cooler than any climate experienced now in central and southern India.
- "(2) The glaciers during the period of ice advance reached much lower down the valleys, and glacial boulder beds have been found recently even to be incorporated within the Siwalik succession of northern India.
- "(3) Not only did the glaciers reach to lower levels as a consequence of colder climate, but during the Pleistocene the montane zone must itself have been at smaller elevations. The influence of the glaciation on the climate of the Peninsula must therefore be considered from the dual point of view of an intrinsically colder climate in the mountains and the existence of glaciers at lesser elevations than even the present heights of maximum ice advance indicate. During the phases of maximum glacier advance the snouts of the glaciers may have been, from combined climatic and isostatic

causes, some 6,000 to 8,000 feet lower than at the present time.

- "(4) It is difficult to avoid the conclusion that these conditions in the montane and bordering zones of northern India must have resulted in a diminution of the temperature in the region now represented by the Satpura and Vindhyan ranges. A lowering of the mean annual temperature in these regions of only 20° to 30° F.,¹ which could still be considerably above the freezing temperature of the glaciated region to the north, would permit much greater run-off and larger river discharges for an equivalent rainfall.

- "(5) The greater relative humidity and higher river discharges would perhaps be sufficient explanation for the migrations of the faunas postulated."

With regard to the present Garo-Rajmahal Gap, Auden (pp. 315-340) first reviews the sequence of geological events which have taken place in northern India since the Gondwana period. He lays stress on various unconformities, in particular that at the base of the Deccan Traps, on crustal tension during the period of eruption of the traps, and on uplift taking place concomitantly with erosion which vitiates direct calculation of former elevations from the amount of rock removed by erosion. After concluding that there is little geological evidence for supposing that any major range formerly existed in mid-Tertiary times along the present Vindhyan-Satpura trend, he discusses the climatic factors which may have contributed towards an increased percentage of run-off from a given precipitation. As regards the Garo-Rajmahal Gap, he gives the following tentative conclusions:—

"It is considered probable that a connection did arise between the Shillong plateau and the peninsula during the Miocene and that the final break causing the present Garo-Rajmahal Gap took place during the Pleistocene along a N.W.-S.E. line of fracture extending from the Darjeeling-Himalaya to Comilla and Chittagong. Consequently, it is necessary to suppose that while the central part of the peninsula was undergoing mild uplift during the Pleistocene,

1. It seems to me that the actual amount is likely to have been much less than this. Nevertheless any lowering of the temperature will reduce evaporation and, therefore, increase the run-off even without a rise in precipitation.—F. E. Zeuner.

the bordering areas of Cutch, Saurashtra, and northern Bengal were subjected to depression".

On the other hand, Dey (p. 409) in a short article on "The Age of the Bengal Gap", has considered it "impossible, on available evidence, to accept the idea of a belt of hills across the Bengal Gap, Chota Nagpur, etc., within the time range of living animal species. The vast depression of temperature during the glaciation of the Himalayas (glaciers certainly come below 5,500 ft. and possibly well below 4,000 ft., in the Kangra Himalayas) seems to provide a more reasonable alternative". Dey's contentions are not borne out by the biogeographical researches reported in the Symposium and, as indicated in this review, the gap did not exist at least from the early Tertiary times to the late Pleistocene period.¹

In any Pleistocene research, the evidence from stratigraphy can be very confusing and in such cases biogeography can be extremely useful. The evidence of biogeography recorded in the Symposium on the "Satpura Hypothesis" is clearly in favour of a hilly track bridging up

1. I agree that there is little geological evidence for a major range of hills. I do think, however, that Dey's views have a fairly strong background from the geological evidence and that it is no use overlooking this fact. The arguments having been taken from two different disciplines are inevitably becoming very involved and it seems to me that we have to be very careful and try to steer a straight course instead of arguing in a circle. What I mean is this. Biogeographical evidence of actual distribution of species, etc., calls for an explanation. The easiest explanation would be the former existence of a range of hills across the Bengal Gap. Geological evidence is not on the whole in favour of this explanation. This I think is the matter in a nutshell. It is necessary to try to find a way out of this deadlock. One way is to construct a connection *via* the Himalayas and Rajputana. Another is to change the climate in certain ways so as to get the species through Bengal without requiring a mountain range, and there are other possibilities. This is, of course, the very reason why you have been encouraging a discussion of the whole Satpura Hypothesis and I think that a lot of good work has been done as a result of this, but I feel that we must not go so far as to regard the biogeographical distribution as evidence that a mountain range across the gap existed. The problem is certainly quite as serious, and your merit in having drawn attention to it is quite as great, no matter what the ultimate explanation of this interesting phenomenon will be. Quite honestly I do not believe that we have found the answer yet.—
F. E. Zeuner.

the gap between the Shillong plateau and the Chota Nagpur plateau. As regards the height of the hills that filled the gap from the Miocene to the Pleistocene periods, the position is not quite clear, but the following account of "Dunn's Uplifts in Chota Nagpur" after Auden (p. 328) is very significant in this connection:—

"Dunn has concluded that at the latitude of Rajmahal (25°) the crust has undergone little change in elevation since the Jurassic, and has acted as a hinge zone. North of the hinge there has been progressive down-warping in response to the Miocene and later Himalayan movements, which has allowed the accumulation of over 6,000 feet of freshwater alluvial sediment in the north Bihar basin. Nearly the whole pile of these sediments now lies below sea-level (Wadia and Auden, 1939, pp. 133-35). South of this hinge there has been progressive uplift, which has been summarized by Dunn as follows (1939, p. 141):—

1. Uplift of 1,000 feet of an early tertiary peneplane, with a downward tilt to the north-east.
2. Middle or Upper Tertiary uplift of 1,000 feet reaching a maximum in the Ranchi Plateau, with downward tilt to the north-east.
3. Further uplift of 300 feet.
4. Final uplift of 400 feet.

The total uplift in the Chota Nagpur area along latitude 23° was therefore of the order of 2,500 to 2,700 feet, with nil movement along latitude 25°. Since this uplift has been taking place during the Tertiary and Pleistocene, it is evident that in early Tertiary times the land was at a lower elevation, and there is not much support for the idea of a major range existing to account for the migration of faunas".

In view of the fact that during the pluvial periods, when the temperatures were considerably lower and the precipitations higher, low hills provided the same ecological conditions for the migrations of faunas as do the higher hills of the present-day topography of India.

A summary of the above results would indicate that:

- (i) In the early Tertiaries, there were lowlands in the region of the Garo-Rajmahal gap.
- (ii) This gap began to be filled up in the Miocene and progressively continued to be filled up even upto the early Pleistocene,

- (iii) The present gap appeared probably in the late Pleistocene, about the same time as the dismemberment of the Indo-Brahm or the Siwalik River.
- (iv) During the pluvial periods when the sea level fell by 100 to 200 meters, the height of the hills relative to the level of the sea increased by the same figure and thereby induced heavier precipitation in the hilly areas.¹
- (v) During the Pleistocene when the central part of the Peninsula was undergoing mild uplift, the flora and fauna became dispersed to the hills to the north and south of the Vindhya-Satpura Trend.
- (vi) The discontinuity of the Vindhya-Satpura Trend in the region of the Garo-Rajmahal Gap and in the regions of Cutch and Saurashtra occurred during the Pleistocene.

THE SATPURA HYPOTHESIS

In the light of the findings contained in the two Symposia on biogeography, let us now study the Satpura Hypothesis in detail and indicate the lines along which further research should be carried out. Though in the Symposium, attention has mainly been paid to the distribution of Malayan fauna and flora to Peninsular India, the original proposition made in 1937 implied several other biogeographical considerations which may now be taken up. In 1937, it was stated:²

"As the Himalayas rose to a great height in the region of the isthmus (mostly the western part of the Assam Himalayas and the eastern part of the Nepal Himalayas) all the evidence concerning the north-eastward extension of the Indo-Brahm seems to have been obliterated. The uplift movement was probably most active in this region as we find practically all the highest peaks of the Himalayas clustered round this area. This differential movement which probably occurred late in the Miocene period, must have obliterated all traces of the eastward extension of the Indobrahm and also acted as a barrier between the eastern and the western Himalayan fishes. The new stock of specialized hill-stream fishes from the east, not finding means to cross this barrier, were deflected towards south-west along the Satpura Trend which probably at that

period stretched across India as a pronounced range from Gujrat to Assam Himalayas. From Gujrat the hillstream fauna migrated towards the south along the Western Ghats and spread to the hills of the Peninsula in the extreme south".

Since the enunciation of the above hypothesis, considerable field work has been done on the distribution of fishes which is summarized in the Symposium. The distribution of specialized fishes along the southern face of the Himalayas has now been investigated by Shri. A. G. K. Menon, longitude by longitude, with very interesting results. As the results of his investigations are not yet published, I am indebted to him for the use of certain amount of this data here. In view of the advances that have been made during the last 13 years, it is necessary that the thesis should now be redefined so as to encourage more research being focussed on the problems arising out of it.

1. Southern China, mostly the Yunan region, was the cradle of the fauna of south-east Asia.
2. From the Yunan area, through earth movements, river captures, etc., the fauna spread to the east, south-west and south on the one hand and to the west, south-west and south on the other. This dispersal would seem to have commenced when the Philippines and islands of the Indo-Australian Archipelago north of the Weber Line were connected with the mainland in the east and Ceylon formed a part of India. At that period there would appear to have been a hilly connection between the Himalayan chain of mountains and the north African hills through Persia, Syria, Arabia and Scotra. This enabled the hill-stream fauna of south-east Asia to spread to Africa.
3. This dispersal probably commenced in the Eocene for in the Inter-trappean beds of Dongargaon, C.P., fossil remains of modern widely distributed species of sluggish waters have been found.
4. Judging from the fact that the island of Ceylon "was first severed during the Miocene epoch when a wide arm of the Tertiary sea extended across the southern parts of the peninsula" (Jacob, p. 341), the following biogeographical conclusions would seem irresistible:—

- (i) The dispersal of the hill-stream fishes of such genera as *Nemachilus*, *Garra*, *Tor*, etc., had taken place before the first appearance of the Ceylon-India

1. I do strongly support this point, that a eustatic drop in the sea-level of 600 feet is likely to have had quite considerable climatic implications.—*F. E. Zeuner*.

2. Hora, S. L., *Rev. Ind. Mus.*, 1937, **39**, 251-59.

gap and at that time the fauna was spreading to Africa along the Himalayas and to Ceylon along the Satpura Trend of mountains and the Western Ghats. It would imply that the Garo-Rajmahal Gap had already been filled up with low hills. This would thus be the Middle or Upper Tertiary period.

(ii) The next group of fishes, as indicative of the phase of dispersal, could be the remarkable torrential fishes of the family Homalopteridæ. This family is known practically from all over south-east Asia but its range does not extend to Ceylon or to Africa. In fact, along the Himalayas it does not extend westwards beyond longitude 85°. The inferences are:

- (a) The dispersal of the Homalopteridæ commenced in the Upper Tertiaries when the hilly connection between India and Ceylon had already severed.
- (b) The dispersal of the Malayan element from the eastern to the western Himalayas was checked in the Upper Tertiaries.
- (c) The Garo-Rajmahal Gap had by that period a series of hills filling up the gap and with perennial torrential streams enabling the dispersal of the Homalopteridæ.
- (d) The age of the dispersal of the Homalopteridæ is further confirmed by the speciation data.

5. Dispersal of animals and plants, aquatic, semi-aquatic and terrestrial, seems to have been facilitated by the pluvial periods of the Pleistocene glaciation; while the arid interglacial periods, isolated stocks of species and the segregation of stocks induced speciation. From the biogeographical data presented in the Symposium on the Satpura Hypothesis, the following inferences can be drawn:—

- (i) The most direct connection permitting dispersal of hill-stream fishes from the Assam Hills to the Chota Nagpur

plateau and the Vindhyas would certainly have been across the present Garo-Rajmahal gap. Geological evidence for a connection in late Tertiary times is somewhat equivocal, but it has been shown that major earth movements involving folding, overthrusting and tear faulting occurred in northern India during the Pleistocene, and would have been sufficient to have severed the bridge during the Pleistocene if, as some geologists consider, the bridge did exist. Reasons are given on page 329 of the Symposium which indicate that no connection probably existed in the Pleistocene between the Monghyr hills and the Nepal-Darjeeling Himalaya, but there may have been a connection along an extension of the Aravalli range.

- (ii) There are successive waves of migrations of terrestrial animals corresponding to the numbers of the pluvial periods. Some work on the double and triple invasion has been done on fishes and birds but lot more remains to be done in all other groups of animals and plants.
- (iii) The environmental facilities for dispersal could be more helpful to the terrestrial organisms but not to the same extent in regard to the aquatic forms, particularly specialized hill-stream fishes for the living of which perennial, torrential streams are essential.

One is able now to say with certainty that there is little evidence of the Ethiopian Element in the fauna of India while the circumstances of dispersal make it abundantly clear that there is a considerable Indian element in the fauna of Africa. The Symposium on the "Satpura Hypothesis" has broadened our outlook by permitting excursions into the realm of other sciences and the Symposium on "Pleistocene Research" has helped us to evaluate some of our views in a comparative way.

S. L. HORA.

PLUTO'S DIAMETER

THE Hale telescope has now been used visually to measure the apparent diameter of Pluto, at the Yerkes and McDonald Observatories, U.S.A. The planet is now believed to have a diameter 0.45 times that of the earth, placing it between Mars and Mercury in order of size in the solar

system, and corresponding to a linear diameter of about 3,550 miles.

Its atmosphere is estimated to be less than 0.1 terrestrial atmosphere, and its mass slightly below 1/10 that of the earth.

—Courtesy of *Sky and Telescope*, October 1950.

THERMAL SCATTERING OF LIGHT IN BIREFRINGENT CRYSTALS

V. CHANDRASEKHARAN

(Department of Physics, Indian Institute of Science, Bangalore)

THE existence of a genuine diffusion of light in a crystal was first recognised by Sir C. V. Raman.¹ The phenomenon arises from thermal agitation and may, therefore, be called thermal scattering. In Brillouin's theory,² the effect is ascribed to a "coherent reflection" of the light waves by the periodic stratifications produced by elastic waves of thermal origin in the crystal. The moving elastic waves would give rise to spectral shifts in the diffused light, which are in the nature of a Doppler effect. Since 1930, several investigators including Mandelstam, Landsberg and Leontowitsch,³ Tamm,⁴ Mueller,⁵ Gross,⁶ Bhatia and Krishnan,⁷ and Kastler⁸ have considered the theory of thermal scattering in crystals and the Doppler shifts occurring in them. The picture that is generally accepted at present is that in a crystal, whether birefringent or not, only three pairs of Doppler components occur, due respectively to the three types of elastic waves which are propagated with different velocities in any given direction. However, none of the authors have specifically considered the effect of birefringence on the Doppler shifts. When this is examined in detail, the remarkable result emerges that there are, in general, not three but *twelve* Doppler components which can occur for a *birefringent* crystal. A short discussion of these new results is given below.

The expression for the magnitude of the shifts can easily be derived either on the basis of the quantum ideas or of the classical wave theory and the results are the same in either case. The Doppler shifts of the components of the scattered light depend on the velocity of the elastic wave as well as on the velocities of the incident and of the scattered light waves. Inside a birefringent crystal the incident light wave (*i*) divides itself into two waves which, in general, travel with different velocities and are polarised in mutually perpendicular planes. Similarly, the scattered wave (*s*) can travel with either of the velocities corresponding to the two states of polarisation of the wave. Let n_i (and n_s) be either of the two refractive indices of the crystal for the direction of incidence (and of scattering) and let λ be the wave-length of the incident light in vacuum. Then the conditions for coherence of phase of the scattering by the different volume elements lying on a particular stratification are (a) that

the stratification should be normal to the plane of scattering and (b) that it should make angles θ_i and θ_s with the direction of incidence and that of scattering, such that

$$n_i \cos \theta_i = n_s \cos \theta_s \quad (1)$$

$$\theta_i + \theta_s = \theta, \quad (2)$$

where θ is the angle of scattering.

Further, the condition for the coherence of phase by volume elements lying on successive stratifications is:

$$\lambda_r = \frac{\lambda}{\sqrt{n_i^2 + n_s^2 - 2n_i n_s \cos \theta}} \quad (3)$$

where λ_r is the wave-length of the elastic wave.

The Doppler frequency shifts $\Delta \nu$ of the components of the scattered radiation are the same as the frequency of the appropriate elastic waves, and are given by:

$$\frac{\Delta \nu}{\nu} = \pm \frac{v_e}{c} \sqrt{n_i^2 + n_s^2 - 2n_i n_s \cos \theta}, \quad (4)$$

where c is the velocity of light in vacuum and v_e is the velocity of the elastic wave giving rise to scattering.

The characteristics of the scattered radiation may be analysed using the four fundamental equations (1) to (4). Since n_i and n_s can each take two values, there would be four pairs of values for (n_i, n_s) in equation (4) and consequently four values for λ_r and θ_r (and θ_s). Further, for a given direction of elastic wave normal, there are three types of elastic waves, each of which has a different velocity v_e . Thus, from equation (4), it is seen that there must, in general, be $3 \times 2 \times 2 = 12$ values for the frequency shifts ($\Delta \nu$). Therefore, the light scattered by a *birefringent* crystal, like calcite, must consist of *12 pairs of Doppler shifted components*. The possibility of such a large number of components has not been previously envisaged.

Equations (1) to (4) are symmetrical with respect to the suffixes *i* and *s*. Consequently, if the direction of incidence and that of scattering are interchanged, the frequency shifts of the components would remain unaltered.

For a given direction of incidence and of scattering, the two polarised incident light waves may be designated A and B and the two polarised scattered waves P and Q. Since either incident wave A or B can, in general, give rise to either of the scattered waves P or Q, the scattered radiation consists of four "species" P_A, Q_A, P_B and Q , each with a dis-

tinctive polarisation character. Each species will consist of 3 pairs of Doppler components due to the three elastic waves. By the use of a proper polarising device, such as a double image prism, in the incident path to separate A and B and another in the scattered path to separate P and Q one can independently study the four species of the scattered radiation.

In certain circumstances, it is possible that for some of the four species, $\cos \theta > n_i/n_s$ or n_s/n_i . Then the wave front of the elastic wave responsible for the scattering lies outside the internal angle between the directions of the incident and scattered wave normals. In such cases, the process of scattering must be regarded appropriately as "coherent refraction" of light wave by elastic waves.

If we consider scattering in the exact forward direction ($\theta = 0$), then the shifts for two Doppler components, say P_A and Q_B are zero, but the shifts for Q_A and P_B components are finite, but equal to each other. We thus have the strange result of a refraction without change of direction, but with change of frequency. In calcite, the magnitude of the shift is as large as 0.22 cm^{-1} when light of wavelength λ 2537 is incident perpendicular to the optic axis.

In the case of a single refracting medium $n_i = n_s = n$ and therefore, equation (4) reduces to the familiar expression

$$\frac{\Delta \nu}{\nu} = \pm \frac{2v_e}{c} n \sin \frac{\theta}{2} \quad (5)$$

Then all the four species have the same shifts

and there can only be 3 pairs of Doppler components. The effective elastic wave front always bisects the internal angle between the incident and scattered directions and the scattering process may therefore always be regarded as "specular reflection". Further when $\theta \rightarrow 0$ $\Delta \nu \rightarrow 0$ and therefore, in the forward scattering the frequency shifts are vanishingly small.

To give an idea of the differences in the Doppler shifts for the four species, the calculated values of the frequency shifts are given below for backward scattering along the normal to the cleavage face of calcite for λ 2537 excitation. They are in cm^{-1} $P_A - 3.31, 1.43, 1.24$; $Q_A - 3.06, 1.32, 1.15$; $P_B - 3.19, 1.38, 1.19$; $Q_B - 3.19, 1.38, 1.19$. The differences are well within the limits of measurement and some experiments have been made which support these ideas. The full details are, however, reserved for another communication.

The author wishes to thank Prof. R. S. Krishnan and Dr. G. N. Ramachandran for their keen interest in the problem and the National Institute of Sciences for the award of the Junior Research Fellowship.

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1950 NOBEL AWARDS FOR CHEMISTRY AND MEDICINE

THE Nobel Prize for Chemistry has been awarded this year jointly to the German organic chemists, Prof. Otto Diels and Prof. Kurt Alder. They were the co-discoverers in 1929 of the well-known reaction, which has since been called the Diels-Alder Reaction. The reaction consists in the addition of compounds containing a conjugated system of double bonds quantitatively to compounds containing groupings like $\text{CH}:\text{CH}:\text{CO}$ to form cyclic compounds. Both Diels and Alder have continued to develop and apply this technique of "Diene Synthesis" to various problems during the last two decades. These studies have played a large part in the preparation of synthetic rubber. Diels is also the author of a well-known text-book of Organic Chemistry in German, which has since been translated into many other languages.

The Nobel Prize for Medicine has been awarded jointly to Drs. Philip S. Hench and Edward C. Kendall, of the Mayo Clinic, Rochester, Minnesota, and to Prof. Tadeus Reichstein, of the University of Basle, Switzerland. This recognizes not only the recent outstanding work (first published last year) on the treatment of rheumatoid arthritis with cortisone and A.C.T.H., but Dr. Kendall's earlier important contributions to biochemistry—the first crystalline preparation of thyroxine in 1914, the first synthesis of glutathione in 1929, and numerous chemical studies of the adrenal cortical hormones—and also Dr. Reichstein's fundamental chemical work on the steroids of the cortex which led him to the original discovery of cortisone, in 1937, and of desoxycorticosterone acetate, as well as his successful synthesis of vitamin C in 1933.

RESEARCH IN RELATION TO THE DEVELOPMENT OF THE PHARMACEUTICAL INDUSTRY

IN the course of his inspiring address to the Indian Pharmaceutical Congress Association held at Calcutta during the last week of December 1950, Sir J. C. Ghosh, Director, Indian Institute of Technology, Kharagpur, recalled the great and pioneering work of Acharya Ray, which helped to forge the closest links between chemistry and pharmacy. He said: "All knowledge is one, specially when that knowledge is dedicated to the common task of improving the health of our people and curing the diseases so frightfully prevalent in this country. May the members of this Congress and all those who are gathered here today, dedicate themselves, and not their knowledge alone to the great task!

"We are living at the dawn of a new era. We must strive hard that this dawn does not fade into darkness again, but break into a bright day of better life. Public health is one of the several sectors of national life—perhaps the most important one—in which this battle has to be fought and won" through a planned and concerted mobilisation of pharmacists, medical men, chemists and their sympathisers in other allied professions.

THE RANK AND FILE MAKE AN ORGANISATION

Sir J. C. Ghosh went on: "Contrary to the view held in some quarters in this country, I believe that a few men at the top cannot make a great organisation. An association ultimately becomes what its rank and file make of it. You have therefore to be very alert about the quality of men who enter your profession. Their professional ethics must be high. Whenever you notice that temptations of commercialism overwhelm character and suppress the ideals of service, you have to take stern action. Things being what they are in India today, disciplinary action against members who bring discredit to your profession, should be, for you, a subject of serious consideration. Your rank and file should not only have high professional ethics but also high professional competence."

KNOWLEDGE IS POWER

Proceeding with his address he declared, "Knowledge is power, but to be really effective, this knowledge must be up-to-date. However keen the struggle for existence may be, a member of your association will not be true to his profession if he does not keep his knowledge up-to-date. We have been for long accustomed in this country to medication in the form of compounded dosage of drugs. But in the progressive parts of the world, this kind of medi-

cation is rapidly falling into disuse. Glandular products, antibiotics and, above all, single chemicals, either obtained synthetically or derived from plant and animal sources, are being used more and more as specific remedies for diseases. In Calcutta, one cannot recall too often the great work which Dr. Brahmachari did in stamping out *kalazar* by the use of Urea-Stibamine as a specific remedy. Politicians may disagree, but this single discovery is doing more to bring prosperity to Assam than all other schemes of national reconstruction in that region put together. And mind you, this discovery was made in a laboratory and a hospital which could, by no stretch of imagination, offer reasonable facilities for research. Where there is will to conquer, adverse circumstances may slow down progress, but cannot be an effective deterrent.

CROSS-FERTILISATION OF IDEAS

Fortunately we have in India today many public institutions far better equipped for researches on drugs than Brahmachari's laboratory in the Old Campbell Medical School. You know, far better than I do, the beneficent activities in which they are engaged. I have always felt and pleaded that drug enquiry should not remain the exclusive responsibility of medical institutions. Here is a border region, where cross-fertilisation of ideas from the sciences of physiology, bacteriology, bio-chemistry and organic chemistry may bear wonderful fruit. Accordingly, in the Indian Institute of Science, one such unit of drug enquiry was started based on the collaboration of workers in the allied sciences. Similar centres are also being developed elsewhere. I hope that these centres will in due course, fulfil the expectations of their sponsors.

THE PENICILLIN PROJECT

It is fortunate that the National Government is keenly alive to their responsibilities for developing this branch of research. You will be interested to learn that Dr. Jivraj Mehta and General Sokhey have recently been able to pilot through the Ministries of the Governments of Bombay and India a scheme for the commercial manufacture of penicillin and allied drugs. The projects will be executed with the technical collaboration of a firm of Swedish Consultants at an approximate cost of about 4 crores of rupees, which will be shared equally by the two Governments concerned. One of the commendable features of the project is the emphasis that is laid on researches on anti-

biotics and the continuous quest for newer and better drugs in this field.

SELF-SUFFICIENCY IN DRUGS

The Council of Scientific and Industrial Research, under the leadership of Dr. Bhatnagar have set up a Central Drug Research Institute at Lucknow. As is usual with Dr. Bhatnagar, this institute is being planned to be one of the best of its kind.

He emphasised the urgent need of a rapid expansion of the industry, specially in the field of synthetic drugs and antibiotics, so that *we may attain self-sufficiency in a decade.*

This object can be achieved, if the industry receives (a) the patronage of the consuming public, (b) generous support from the State and (c) if the management have the vision to recognise that research is in this, more than in any other field, the elixir of life of industry.

RESEARCH NOT A LUXURY BUT AN ESSENTIAL REQUISITE FOR PROGRESS

There is a school of thought in this country whose advocates do not believe that scientific and technical research is necessary for the industrial development of the country. They consider that all that is needed is to decide on general grounds if the country has the potential resources in power, raw material and transport, which will justify the establishment of any particular industry, and then import into the country the necessary machinery and experts for the purpose. Wherever necessary they would enter into an agreement for technical assistance with a foreign concern and secure the right to use their patents and access to their 'know-how' on payment of big royalties and fabulous fees. They are in favour of providing such technical education in the country which will enable the industry to be run by indigenous talent after a period of probation under foreign experts. They would strongly support technical and vocational education, but stop at research as being more in the nature of a luxury. I have often met this attitude in our powerful industrial magnates and entrepreneurs in business. To them the history of the dyestuffs industry should be an object lesson. The first synthetic dye was made in England by Perkin, but the industry soon found a congenial home in German soil. In Germany the practical outlook of businessman is, more often than anywhere else, enthused by that faith in scientific research which comes from first-hand knowledge. Thus, twenty long years of painstaking research were necessary at a cost of

more than a crore of rupees before Bayer's process for the synthesis of indigo could be commercialised. But once it was done, the fate of the natural indigo of Bihar was sealed and it disappeared from the world's market in another twenty years. The attitude in Great Britain, on the other hand, was one of complacent 'wait and see'; and the result was that in 1914 she had no dyestuffs industry of any importance. As the war progressed it was realised that the British dependence on Germany for dyes was a fatal mistake. Modern war depends for its successful prosecution on an abundant supply of a large variety of chemicals; and a dyestuffs and fine chemicals industry must be considered an integral part of every defence programme. The British Government took immediate and far-reaching steps. Beginning with a direct and large subsidy for the formation of a company, which ultimately was absorbed in the Imperial Chemical Industries, millions of pounds were spent on developmental research in every branch of the industry. Later on, the importation of dyes and even intermediates were prohibited. As a result, Sir Gilbert Morgan in 1939 claimed with justifiable pride that of the five most fundamental discoveries in dyestuffs chemistry since 1921, the world owed three to British talent. The Imperial Chemical Industries are not only producing now their home requirements but have also in addition a considerable export trade. They have also become pioneers in research on insecticides and anti-malarials. Their gammaxene is now contesting the pride of place with D.D.T. as the most effective insecticide. Their paludrine is now considered the most potent of all anti-malarial drugs. This altered attitude in Great Britain is reflected in the Ormsby Gore Report which observes that "no nation can advantageously depend only on the efforts of other nations for the purpose of promotion of knowledge. This is not only because such dependence is an ignoble parasitism, but also because in the field of international relations no less than in national life, the power that comes from knowledge comes from its early and rapid use and from close contact with men who have created this knowledge. The conviction has now become universal that the nation, which will enjoy the benefits of science in the day-to-day progress of its industries and agriculture, is the nation which habitually applied to them scientific method and scientific knowledge; and it is that nation which will be able to seize the advantage of the more spectacular achievements of science in its economic life."

WEALTH OF INDIA, VOL. II—A PREVIEW

A PART of the second volume of the *Wealth of India* pertaining to Raw Materials—a series publication, sponsored by the C.S.I.R., is scheduled to appear in a couple of weeks. The first volume of this encyclopædic work on the natural resources and the industrial products of India was issued in December 1948. In his foreword to the series, Prime Minister Jawaharlal Nehru said:

"I have found this dictionary fascinating and it has opened out vistas of thought to me. I have no doubt that this book, produced by many scholars and experts and after much labour, will be of great value to the builders of new India."

In the course of their appreciative and critical reviews of the series, some of the international science Journals, wrote that, "This monumental work assembled by a number of Indian scholars supersedes and immeasurably improves on the classic works of George Watt" and added that, "every student of plant utilization will be induced to wish that comparable reference works on economic plants of other countries were also available. It is unquestionably one of the greatest assemblages of information on economically important plants." (Economic Botany).

Nature said, "A high standard is maintained throughout, and the articles contain adequate literature references. The book is fully illustrated with many coloured plates and it is printed on excellent paper. It reflects the highest credit on the Chief Editor and his staff."

Science Progress wrote, "that the authors and editors have accomplished their task with considerable success. The great majority of the articles are models of concise and authoritative statement, references to original literature have

been abundantly provided, and there is a welcome absence of excessive detail."

The second volume just released for distribution comprises articles beginning with the letter C and deals *inter alia* with about 230 genera of economic plants with their numerous species, eight important minerals, and seven animal products. The following classified statement gives the subjects on which information—production, processing, utilisation and trade—has been assembled and presented.

Beverages: Tea, Coffee.

Fibre: Jute, Cannabis, Sann Hemp, Silk Cotton Tree, Caryota, Calotropis.

Fodder: Cenchrus, Cyperus, Cynodon.

Fruits: Papaya, Citrus, Cucumis.

Gums and Resins: Guar Gum, Indian Bdellium, Katira Gum, Black Dammar.

Medicinal Plants: Senna, Chenopodium, Pyrethrum, Ergot, Bhang, Cinchona.

Oil Seeds: Coconut, Carthamus-safflower.

Perfumes and Essential Oils: Camphor, Civet, Lemongrass, Palmarosa.

Pulses: Bengal gram, Red gram.

Root Crops: Chicory, Turmeric, Colocasia.

Spices: Chillies, Coriander, Cumin, Tejpat.

Tans: Avaram, Dividivi.

Vegetables: Canavalia, Cucumis, Cucurbita.

Wood and Timbers: Deodar, Casuarina, Cane, Chikrassy.

Minerals: Coals, Clays, Copper ores.

Animal Products: Cochineal, Camels, Crocodile.

The volume covers 480 pages (8¼" × 11") and is printed on art paper. It is profusely illustrated with line drawings, half-tones, graphs and maps; mono- and multi-coloured plates are included. The volume is beautifully bound in deep blue rexine.

CENTENARY OF THE GEOLOGICAL SURVEY OF INDIA—1851-1951

THE Geological Survey of India, one of the oldest official organisations of its kind in the world, is due to celebrate in January 1951 the first hundred years of its existence as an organised department.

The main celebrations will be held in Calcutta from January 10th to 14th, 1951. These will include an exhibition illustrating the history of the Department and the progress of geological discovery in India, and a Commemoration Ceremony on January 13th. This will be followed by a tour to places of geological and mining interest in Northern India, concluding

at Delhi on January 28th.

To commemorate the occasion, the Government of India have extended a warm invitation to other countries, and to their official Geological Surveys and learned Societies, to participate in the Centenary Celebrations.

The Geological Survey of India, in friendly collaboration with the sister organisations of the world, will, it is hoped, continue to play a vital role in advancing the boundaries of geological knowledge, and at the same time orientate its activities to the pressing material needs of a nation just reborn.

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A NOTE ON JOSHI EFFECT

RAIS-AHMED AND GILL² have offered a new explanation of "Joshi Effect". According to them, (a) most of the gas amplification occurs near the anode and the current is mostly carried by the electrons; (b) irradiation increases ionisation with a corresponding increase in the positive space-charge near the cathode. The increased positive space-charge decreases the field gradient at the anode with a consequent decrease in the gas amplification. Thus, a current decrease on irradiation is to be expected.

This simple explanation is inconsistent with some of the important experimental results:

1. According to the proposed explanation ordinary D.C. discharge tubes should also show the Joshi effect. But Joshi effect appears to be peculiar to the ozoniser discharges which can only be worked with alternating or unidirectional pulsating voltages.

2. The magnitude of the effect should depend on the volume of the gas ionised. Results of Joshi,^{3,4,5,7} Shukla⁹ and Deb and Ghosh¹ clearly indicate the surface origin of the phenomenon.

3. The decrease in the field gradient at the anode will clearly depend on the magnitude of the positive space-charge near the cathode. In the case of halogens, the problem is complicated by the fact that the negative component of the

current is in a good measure carried by the negative ions instead of the electrons. Hence the anode fall of potential in halogens in some cases is as high as thousand volts. Irradiation in the visible cannot, therefore, appreciably affect the anode fall of potential and therefore the field gradient near the anode. The effect on the new mechanism should, therefore, be least in halogens. Results of Joshi⁶ indicate that the effect is maximum in chlorine.

4. Since the decrease in the gas amplification is due to increased positive space-charge density, it is to be expected that the magnitude of the effect should increase with increase in the positive space-charge density (i.e., with increased ionisation) and should therefore be maximum with X-rays. Joshi⁶ finds that *ceteris paribus* the effect is less under X-rays than in the visible. Karmalkar⁸ in iodine vapours observes a positive effect under X-rays, a negative effect under white light and an effect equal to the algebraic sum of the positive and negative effects when irradiated simultaneously with X-rays and white light.

The results are just the opposite of what is expected from the theory of Gill and Rais-Ahmed.² The results however find a simple explanation on Prof. Joshi's theory.⁷

According to Prof. Joshi,⁷ (a) an adsorbed layer, in dynamical equilibrium with the gas

phase, is formed on the dielectric surface during the discharge; (b) on irradiation photo-electrons are emitted from the adsorbed layer; (c) the photo-electrons are converted into the slow moving negative ions due to the electron affinity of the excited gas molecules. These slow moving negative ions decrease the current as in the space-charge effect.

It is evident that any factor which tends to decrease the magnitude of the negative space-charge will tend to decrease the Joshi-effect. The positive effect under X-rays is due to the intense ionisation due to X-rays. The increased ionisation due to X-rays increases the positive space-charge density. This increased positive space-charge reduces, in effect, the negative space-charge formed under light, which according to Prof. Joshi's theory reduces the light effect under simultaneous irradiation with X-rays and white light, as observed.

Grateful thanks are due to Prof. S. S. Joshi of Banaras Hindu University and to Prof. M. F. Soonawala, of Maharaja's College, Jaipur, for their keen interest and kind encouragement.

Physico-Chemical Labs., G. V. BAKORE.
Maharaja's College, Jaipur,
August 31, 1950.

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A NOTE ON JOSHI EFFECT

In a recent note entitled as above, Rais-Ahmed and Gill¹ cite the following equations for the current:

(1) $J_e = J_0 e^{ad}$; (2) $J_e = \rho_e E g$; and (3) $J_i = \rho_i E g_i$. These equations are inapplicable except in a uniform field. For instance, the amplification coefficient a being position dependent in a non-

uniform field, $e^{\int a dx}$ should have been used in place of e^{ad} in equation (1).² Further, most of the ionization needed for maintaining a given current being known to be completed within a critical distance d_c this last and not the full interelectrode distance d is relevant to current stability as implied in equation (1). Another circumstance overlooked by the authors¹ is the disparity in the field intensities E_c and E_a at the two electrodes, E_c at the

cathode being greater than E_a at the anode, except in the positive corona where the reverse holds.³ This contradicts the authors' assumption of E being identical at the two electrodes, in equations (2) and (3).

Furthermore, the authors designate the excited tube as a 'diode'; this is ambiguous. Both positive and negative Joshi effects have been observed over a pressure range of 0.002 mm. Hg⁴, which is not dissimilar to that in a soft diode, to about 800 mm. Hg,⁵ and in various types of discharge tubes, e.g., the full ozonizer, (GM counter-like) semi-ozonizer,⁶ Crookes and Geissler forms of discharge tubes fitted with internal metallic electrodes,⁷ and those excited by external sleeves.⁸ None of these can be described usefully as a diode except perhaps in a distant sense and over a restricted range of operative conditions. The authors' current equations are further defective in that they do not include secondary amplification term distinct from α (Townsend), essential for the stability of the discharge.⁹ Lastly, it may be pointed out that both photo-ionization¹⁰ and a rise of the potential gradient in the cathode region,¹¹ as postulated by the authors, should cause a current increase, radiation that can ionize a gas being known to be one of the possible agents of secondary amplification.¹⁰

The remark, "obviously, if by intense illumination ionization is further increased", envisages Joshi effect as a volume effect. Experimental data from these Laboratories in respect of numerous media and covering a wide range of exciting conditions show that the Joshi effect is fundamentally of surface origin, or more precisely, "solid (electrode)—gas interface".¹² In the end, it may be noted that the work of Fuchs¹³ and Salzwedel¹⁴ cited by the authors and specifically mentioned by me during discussion referred to by them, is limited to ultra-violet irradiation of the metal cathode, which discriminates their finding from the more general Joshi effect.

The Chemical Laboratories, H. J. ARNIKAR.
Banaras Hindu University,
September 22, 1950.

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COMMENT ON NOTES BY G. V. BAKORE AND H. J. ARNIKAR

BAKORE AND ARNIKAR in their notes on 'Joshi Effect' refer to a previous note¹ by Prof. Gill and myself.

Firstly, in the earlier note no new explanation for 'Joshi Effect' was advanced. It was only pointed out that a consideration of gas amplification commonly found in standard textbooks might help to explain the experimental results. W. G. Dow² writing about change of current in gas phototubes clearly says that "under some conditions an increase in illumination may reduce the total tube current". Secondly, the quantity α which was used in the previous note does not pertain to a volume effect. It simply depends on gas concentration, on the exciting and ionizing potentials and their probabilities for the gas used, and on the ratio of field strength to gas concentration. The existence of a highly ionized layer of gas next to the dielectric cathode was not ruled out. In fact, some of the experiments on special Geiger tubes in this laboratory have led us to consider the accumulation of ions on the surface of the glass electrode.

The more exact equations referred to by Arnika do not in any way alter the conclusions which may be derived from the simplified equations. Of course, E_c is greater than E_a but this does not compensate for the fact that the mobility of electrons y_e is very much greater than the mobility of ions g_i . Bakore's example of chlorine does not indicate if the pressure regions, where such great anode falls are encountered, are exactly those where the negative effect is greatest.

The effect still appears analogous to similar phenomena in other types of discharges, and perhaps a conventional explanation can do for this too.

Physics Department,
Aligarh University,
October 12, 1950.

RAIS-AHMED.

1. Rais-Ahmed and P. S. Gill, "A Note on Joshi Effect," *Curr. Sci.*, July 1950, **19**, 206-07. 2. Dow, "Fundamentals of Engineering Electronics," John Wiley & Sons, New York, 1944, 412.

TWO HITHERTO UNREPORTED PLANT FOSSILS FROM THE RAJMAHAL HILLS, BIHAR

A COLLECTION of plant fossils made from several localities in the Rajmahal Hills in Bihar in 1946 and which is being worked out at present, has shown a number of interesting impressions. Two of them hitherto not reported from the Rajmahal Hills, are briefly described in the present preliminary note.

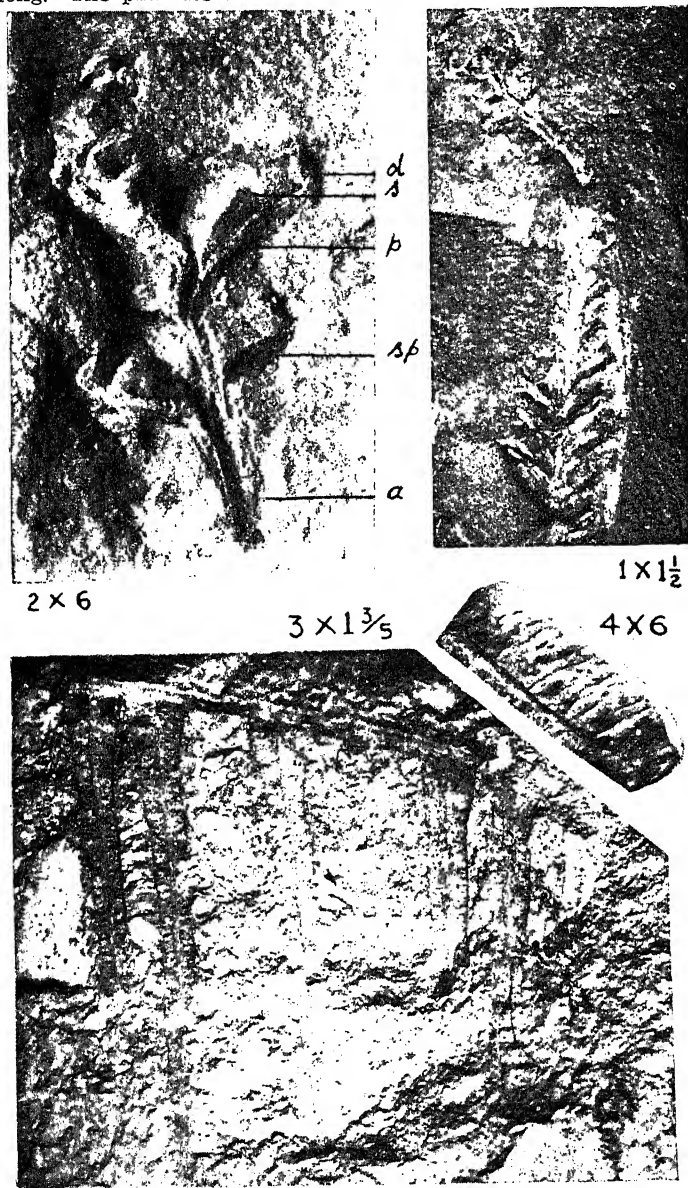
Stachyotaxus sp. (Photos 1-2).—This impression of a fertile specimen is borne on the hard rock characteristic of the well known locality *Onthea*. The specimen is not very satisfactorily exposed owing to the irregular fracture of the rock under the hammer. Still the shoot and its connection with the strobilus is fairly clear although the exact connection is missing (Photo 1). The entire specimen measures about $5\frac{1}{2}$ cm. long by a centimetre broad. The leaves are 5 mm. long, 1 mm. broad, show a narrow twisted base and generally conform to the type known as *Elatocladus conferta*. The apex of the leaves and the epidermal features could not be made out. The axis of the shoot extends into a strobilus (Photo 2); 2 cm. long by .7 cm. broad, bearing distantly and perhaps oppositely arranged sporophylls. Each sporophyll arises almost at right angles to the axis and measures about 7-8 mm. in length. The distal part of each sporophyll is bent at right angles and bears two sockets which evidently bore the two seeds. They measure about 4 mm. long by 1.5 mm. broad, were probably drupaceous in nature and their micro-pyles faced the axis of the strobilus. The seeds are not fully preserved but the compressed seed coat can be seen clearly. The exact shape of the seed and its mode of attachment to the sporophyll is not very clear.

Nathorst (1908) who instituted the genus *Stachyotaxus* described two species—*St. elegans* and *St. septentrionalis* from Sweden. My specimen resembles to a certain extent the latter species. Halle (1913, p. 83) pointed out the resemblance between *Stachyotaxus* and some twigs of *Elatocladus* from Grahamland. My specimen resembles rather very closely the megastrobilus known as *Beaniopsis rajmahalensis* Ganju (1947, p. 95) also described from the Rajmahal Hills. The foliage of this is not known. The longer axes of the two seeds on each sporophyll diverge from each other, but their principal planes are in continuation with each other. These seed characters if they are the normal feature of the plant and not due to any accident in preservation, constitute the

main difference between *B. rajmahalensis* and my specimen.

Laccopteris (*Phlebopteris*) sp.—This interesting fragment (Photo 3) is part of a pinnate fern frond and is 4 cm. long. The pinnules are seen

angles and is attached to the longitudinally striated rachis by its entire width. The pinnule measures about $\frac{1}{2}$ cm. at the base and gradually tapers down to an acute tip about 1 mm. broad; the margin appears to be slightly



1. *Stachyotaxus* sp. part of shoot with strobilus; the exact connection is missing, $\times 1\frac{1}{2}$. 2. Strobilus magnified—*sp*, sporophyll; *p*, proximal, *d*, distal upturned, part, *s*, seed *a*, axis, $\times 6$. 3. *Laccopteris* (*Phlebopteris*) sp. part of incomplete pinna showing some pinnules on one side only. $\times 1\frac{3}{5}$. 4. Part of pinnule showing the soral bulges on the upper surface $\times 6$.

on only one side and only 5 are preserved and the bases of three more can be made out. The longest of the pinnules measures about 4.5 cm. in length. The pinnule arises almost at right

revolute. The conspicuous midrib is grooved on the upper side and striated on the lower side. The venation is of the *Laccopteris* type with the basal meshes which however are not

very many. Most of the fertile leaves have lost the sporangia, probably before fossilization, but their position can be made out by the bulges on the upper surface in the region of the sorus (Photo 4). The sori occur in two rows on both sides of the midrib, not more than 1 mm. from each other and generally consist of six round sporangia grouped together. My specimen shows some points of resemblances with *L. polypodioides* (Seward, 1910, p. 358), but I would prefer to postpone its specific determination till more satisfactory material is available. The above two well-known Rhaetic plant fossils recorded for the first time from the Rajmahal Hills serve to link the Grahamland flora and the Greenland flora on the one side with the Rajmahal flora on the other. The affinities between these floras have already been noted by Halle, Sahni and others.

I am greatly indebted to Prof. T. M. Harris, of Reading University, who examined my specimens and gave some helpful suggestions.

Dept. of Botany,
Lucknow University,
September, 1950.

A. R. RAO.

1. Nathorst, 'Über *Palissya*, *Stachytaxus* und *Palaeotaxus*,' *Palaeobot.*, 1908, Bd. 43, No. 8; *Kungl. Svensk vetenskapskad. Hand.* 43, 8. Halle, "The mesozoic flora of Grahamland," *Wiss. Ergeb. Schwed.*, 1913. Südpolar, Exped. 1901-03 Bd. 3, Lief 14, p. 1. Ganju, "On *Beaniopsis rajmahalensis* gen et sp. nov., a new type of gymnosperm female fructifications from the Jurassic of Bihar," *Proc. Nat. Acad. Sci.*, 1947, 25, 95; Seward, *Fossil Plants*, 1910, 2.

IODINE MONOCHLORIDE AND IODINE TRICHLORIDE AS CHLORINATING AGENTS

IODINE MONOCHLORIDE and iodine trichloride are powerful iodinating agents. G. H. Woollet and W. W. Johnson (*Org. Syn.* 1934, 14, 52-53) obtained 3 : 5-diiodo-salicylic acid by the action of iodine monochloride on salicylic acid in glacial acetic acid. Colbert, Houghton, Schmidt and Abernathy (*J.A.C.S.* 1944, 122-4) prepared 3-iodo and 3 : 5-diiodo-4-hydroxy diphenyl in a similar manner. The reagent was used by A. H. Blatt (*Org. Syn.* 1943, 343) for the preparation of 3 : 5-diiodo-salicylic acid.

We attempted iodination of (1) 2-hydroxy 3-naphthoic acid, (2) alizarin and (3) 4,4'-dihydroxy diphenyl by the action of iodine monochloride in glacial acetic acid. The reactions were studied both at room tempera-

ture and 100° C. The action of iodine trichloride has also been studied on (2) and (3) at 100° C.

1 g. of each of the compounds was dissolved in 20-25 c.c. of hot glacial acetic acid and the solution after cooling to room temperature, was treated with 15-20 c.c. of ICl solution for about an hour and the reaction mixture was set aside for 4-12 hours (depending upon the compound used) and then worked up for the product. The crystalline derivatives gave negative tests for iodine and positive for chlorine. They were then identified by mixed melting point with authentic samples of the chloro derivatives prepared and identified earlier by standard method.

The reaction with all these compounds at both the temperatures was quite rapid, but instead of iodo derivative being formed as expected, the products obtained were identified as the chloro derivatives. Not even traces of iodo derivatives were isolated. 2-hydroxy-3-naphthoic acid gave 1-chloro, alizarin, the 3-chloro and 4,4'-dihydroxy diphenyl, the 3 : 5 : 3' : 5' tetrachloro derivatives. The yields of the chloro derivatives were excellent:—(1) gave 63 per cent. and 74 per cent., (2) gave 68 per cent. and 75 per cent. and (3) gave 67 per cent. and 69 per cent. at room and at water-bath temperatures respectively. With iodine trichloride the yield of the tetrachloro derivatives was still higher, i.e., 71 per cent. while that of 3-chloro alizarin remained 75 per cent. only.

It seems that the probable explanation is as follows: Iodinemonochloride in glacial acetic acid exists in two ionic forms— I^+ + Cl^- in dynamic equilibrium with I^- + Cl^+ . Since both chlorination and iodination are cationoid reactions and since both Cl^+ and I^+ exist at any time in the reaction mixture the chances of formation of both the derivatives chloro as well as iodo are equal. However, the factors like stability of the final product determine the course of the reaction. Since in the case of these three compounds (1), (2) and (3) C-Cl bond is relatively more stable than the C-I bond, it is probable chlorination takes precedence over iodination. Further, more systematic work is being undertaken in our laboratory to establish the conditions under which ICl and ICl_3 would function as chlorinating agents.

A. M. GANDBHIR.

A. L. N. FONSECA.

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V. V. NADKARNY.

St. Xavier's College,
Bombay-1,

October 24, 1950.

SYNTHESIS OF 2:3-CYCLOPENTENO-NAPHTHALENE AND ITS 7-METHYL DERIVATIVE

2:3-CYCLOPENTENONAPHTHALENE (5 : 6-Benzohydrindene) and 7-methyl-2:3-cyclopentenonaphthalene, have been synthesised as follows: (1) Δ' -cyclopentene-1 : 2-dicarboxylic acid anhydride condensed with benzene in presence of anhydrous aluminium chloride with the formation of Δ' -cyclopentene-1-benzoyl-2-carboxylic acid (m.p. 181-182°, semicarbazone m.p. 240°). This ketoacid on reduction by the Clemmensen method gave Δ' -cyclopentene-1-benzyl-2-carboxylic acid (b.p. 170-173°/4 mm., anilide m.p. 130°-131°). This was cyclised by heating with fused zinc chloride to 1-keto-2:3-cyclopenteno-1 : 4-dihydronaphthalene (b.p. 145-150°/5 mm.; semicarbazone m.p. 177°-178°) which on reduction by the Clemmensen method gave 2 : 3-cyclopenteno-1 : 4-dihydronaphthalene (b.p. 105-107°/5 mm.). The latter on dehydrogenation with Pt-C catalyst in the liquid phase gave 2 : 3-cyclopentenonaphthalene or 5 : 6-benzohydrindene (m.p. 95°; picrate m.p. 120°-121°; styphnate m.p. 153°) identical with a sample prepared previously by a different route.¹

(2) In a similar manner, Δ' -cyclopentene-1-(p-toluy)-2-carboxylic acid (m.p. 200°; semicarbazone m.p. 230°) was obtained from toluene and Δ' -cyclopentene-1 : 2 dicarboxylic acid anhydride. This on Clemmensen reduction gave Δ' -cyclopentene-1-(4'-methylbenzyl) 2-carboxylic acid (b.p. 175-176°/3 mm.; anilide m.p. 143°) which on cyclisation with zinc chloride gave 2 : 3-cyclopenteno-1-keto-1 : 4 dihydro-7-methyl naphthalene (m.p. 55°; semicarbazone m.p. 208°). The keto compound on Clemmensen reduction gave 2 : 3-cyclopenteno-1-4-dihydro-7-methylnaphthalene (m. p. 53°), which on dehydrogenation with Pt-C catalyst gave 2 : 3-cyclopenteno-7-methylnaphthalene (m.p. 104°, picrate m.p. 107°-108°) identical with 6 : 7-cyclopenteno-2-methylnaphthalene which was obtained by a different route.¹ The experimental details will be published in due course. This method is being actively pursued for the synthesis of similar polycyclic hydrocarbons.

Chemical Laboratory, S. C. SENGUPTA.
Krishnagar College, N. N. SAHA.
Krishnagar, Nadia,
West Bengal,
October 3, 1950.

THE CHLORINE-SULPHITE TEST FOR LIGNIN

THE pink colour that a ligno-cellulose gives with chlorine and sodium sulphite solution is generally employed as a test for residual lignin during the estimation of cellulose by Cross and Bevan or Norman and Jenkins method.¹ Both native and isolated lignin respond to this colour reaction. Lignin is believed to form chlorolignin which dissolves in the sulphite solution with a pink colour. But it has recently been observed in these laboratories that a boiling-water extract of jute and some other bast fibres gives this test. The deep brown solid obtained on evaporating the aqueous extract of jute, is acidic in nature, reduces Fehling's solution, has about 13 per cent. methoxyl, dissolves mostly in 72 per cent. sulphuric acid, as also in acidified sodium chlorite solution at about 100°, and yields galactose on hydrolysis with dilute sulphuric acid.

Since it is difficult to imagine the presence of lignin in the aqueous extract of a ligno-cellulose, the development of a pink colour with chlorine and sodium sulphite may not be a sure test for lignin. The water-soluble fraction of jute fibre presumably contains a precursor of lignin, or some compound having a common group, responsible for the colour.

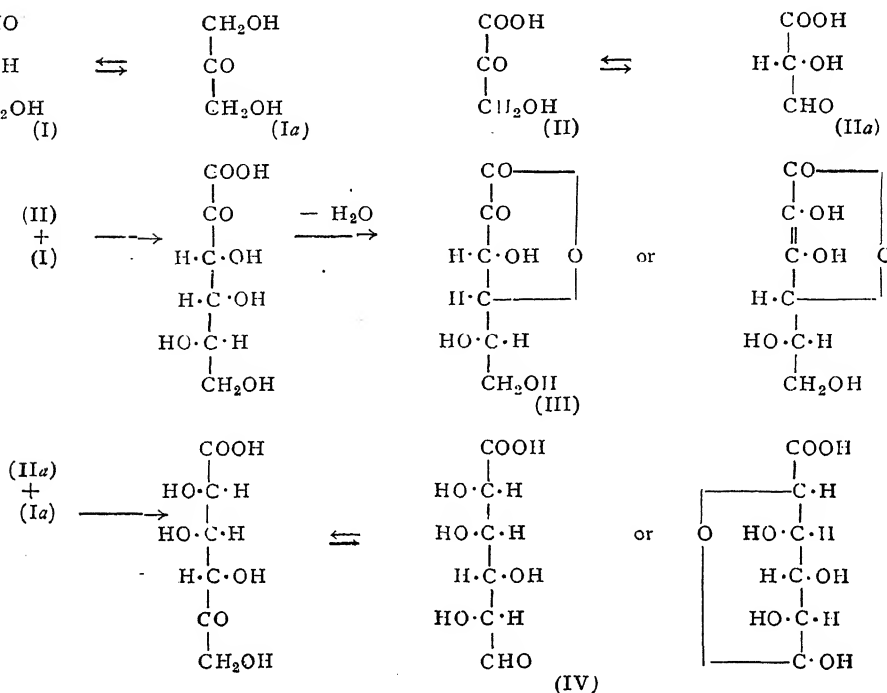
Another interesting fact is that this pink colour is given by the hot 5 per cent. sulphuric acid extract (in Norman and Jenkins method for the estimation of lignin²) as well as the 3 per cent. boiling sulphuric acid extract of lignin (in Mahood and Cable's method³), indicating apparently some loss of lignin in either case.

Tech. Res. Labs., P. B. SARKAR.
Indian Central Jute Committee,
Regent Park, Tollygunge,
Calcutta-33,
October 21, 1950.

1. Doree, *The Methods of Cellulose Chemistry*, 1947, pp. 352-8. 2. Norman and Jenkins, *Biochem. J.*, 1934, 28, 2147, 2160. 3. Mahood and Cable, *Ind. Eng. Chem.*, 1922, 14, 933.

THE BIOGENESIS OF ASCORBIC ACID

OF the work reported so far on the possible mechanism of synthesis of ascorbic acid *in vivo* and its immediate precursors, that of C. G. King and collaborators¹⁻⁴ appears to give us a significant clue. As a result of their very systematic work carried out in the rat, they arrive at *inter alia* the following conclusions: (1) the ingestion



of "a great many compounds of widely varying molecular constituents" (such as the monocyclic and bicyclic terpene ketones, aliphatic alcohols and ketones, barbiturates, aminopyrin, antipyrin, etc.) cause an increased rate of synthesis and excretion in the urine of ascorbic acid which was identified beyond doubt; (2) "it is improbable that the substances served as direct precursors of ascorbic acid", but they cause "a stimulation of the synthesis of ascorbic acid from the intermediate metabolites";² (3) the compounds that stimulate this synthesis are detoxified as the glucuronides and "there appears to be a striking correlation between the metabolism of *D*-glucuronic acid and *L*-ascorbic acid";³ (4) the ascorbic acid synthesised is of endogenous origin, formed from the tissue metabolites in the same way as *D*-glucuronic acid, and (5) in the study of the synthesis of ascorbic acid by the rat tissue *in vitro*, the best results were obtained with a mixture of glyceraldehyde, pyruvate and hexose diphosphate (glucose, mannose, sorbose and 1-2-ketogulonic acid being ineffective).⁴

The above appear to us to indicate clearly that the formation of *D*-glucuronic acid and ascorbic acid is simultaneous and that they arise out of the same precursors by reaction in two different ways which explain satisfactorily why the compounds that get detoxicated as the

glucuronides cause the increased synthesis of ascorbic acid also. We suggest that they are formed from two three carbon units by aldol condensation similar to the formation of fructose and sorbose from two molecules of glyceraldehyde,⁵ the two three carbon units (precursors) in this case being glyceraldehyde (I) and hydroxypyruvic acid (II), their tautomeric forms (Ia, IIa respectively), or their biological equivalents. The reactions can proceed as shown below in two directions yielding in one case ascorbic acid (III) and in the other glucuronic acid (IV).

Glyceraldehyde can arise from the sugars while hydroxypyruvic acid by, (1) oxidation of pyruvic acid or dihydroxyacetone, (2) transamination of serine, or (3) decarboxylation of dihydroxymaleic acid.

Dept. of Chemotherapy,
Haffkine Institute,
Bombay,
August 4, 1950.

K. GANAPATHI.

1. Musulin, Tully, Longenecker and King, *J. Biol. Chem.*, 1939, **129**, 437.
2. Longenecker, Musulin, Tully and King, *Ibid.*, 1939, **129**, 445.
3. —, Fricke and King, *Ibid.*, 1940, **135**, 497.
4. Smythe and King, *Ibid.*, 1942, **142**, 529.
5. Fischer and Baer, *Helv. Chim. Acta.*, 1936, **19**, 519; Schmit, E., *Ber.*, 1933, **66**, 931.

RESACETOPHENONE-OXIME AS AN ANALYTICAL REAGENT FOR THE QUANTITATIVE SEPARATION OF COPPER AND CADMIUM

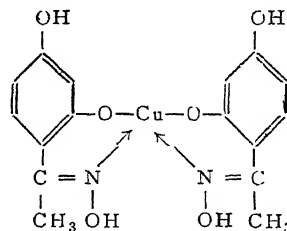
THE aromatic ortho-hydroxy aldoximes and ketoximes yield bright yellow to greenish yellow copper salts, insoluble in dilute acetic acid. Ephraim¹ studied several compounds of this series and found that their specificity for copper appeared only in acetic acid solution. This author and Astin and Riley² employed salicylaldoxime for the detection and determination of copper. It is now widely employed. It is, however, difficult to obtain this reagent in a crystalline form as it has a low melting point, is expensive, and as pointed out by Howe and Mellon,³ dilute aqueous alcoholic solutions are not quite stable.

Among the oximes examined by Ephraim, resacetophenone-oxime possesses several advantages over salicylaldoxime but it has not been examined previously, as an analytical reagent for copper, in detail. The parent ketone and the oxime (colourless crystals, m.p. 198-200° C.) can be easily prepared in very good yield and the reagent is less expensive. This reagent is readily soluble in alcohol and is not precipitated by large dilution with water. Aqueous alcoholic solutions are quite stable for long periods. Copper gives a bulky brownish yellow precipitate in acetic acid solution but cadmium is not precipitated either from acetic acid or ammoniacal solution. Ferrous iron gives a purplish colour in acetic acid solution and ferric iron a dark red colour in presence of hydrochloric acid. Neelakantam and Sitarman⁴ employed the latter reaction for the colorimetric determination of iron. None of the other common metals gives any precipitate or colour.

The copper complex when precipitated in the cold from acetic acid solution, using an alcoholic solution of the reagent is bulky and light. In the hot coagulation occurs but the precipitate does not settle down.

The following procedure gives the best results:—The copper solution is neutralised with sodium hydroxide and acetic acid (10 c.c.; 2N) added. The solution is diluted to 200 c.c. and heated to boiling. An excess of 1 per cent. alcoholic solution of the reagent is added slowly from a separating funnel with constant stirring. Finally the solution is heated gradually to boiling with occasional stirring. The precipitate is filtered hot through a sintered glass crucible (Schott and Gen, No. 4) and washed with hot water containing acetic acid until the

wash liquid gives no colour with ferric chloride. The precipitate is dried to constant weight at 120° C. Drying is complete in 2-3 hours. The results for copper are calculated on the basis of the following structure for the anhydrous complex:



[Molecular formula: $(C_8H_8NO_3)_2 Cu$;
contains 16.06% copper]

These values compare quite well with those obtained by the iodometric and salicylaldoxime methods (Cf. Table I).

TABLE I

No.	Copper (mg.)		
	Resacetophenone oxime	Iodometric method	Salicylaldoxime
1	11.8	11.77	11.75
2	11.79	„	11.79
3	29.45	29.42	..
4	29.47	„	..
5	29.49	„	..

Separation of copper and cadmium carried out by the above method gives good results as shown in Table II.

TABLE II

No.	Copper taken (mg.)	Cadmium added (mg.)	Copper found (mg.)	Error %
1	29.42	25.0	29.47	+0.17
2	„	30.0	29.48	+0.20
3	„	40.0	29.49	+0.24

It is clearly seen that resacetophenone-oxime is quite a satisfactory reagent for the determination of copper and its separation from cadmium. The copper complex contains 16.06 per cent. metal while the corresponding salicylaldoxime complex contains 18.95 per cent. Resacetophenone-oxime is, therefore, recom-

mended as a suitable substitute for the expensive salicylaldehyde.

Chemical Laboratories, N. APPALA RAJU.
Andhra University, K. NEELAKANTAM.
Waltair,
October 26, 1950.

1. Ephraim. *Berichte.*, 1930; **63B**, 1928; *Ibid.*, 1931, **64B**, 1210. 2. Astin and Riley, *J. Chem. Soc.*, 1933, 314. 3. Howe, and Mellon *Int. Eng. Chem. Anal. Ed.*, 1940, 448. 4. Neelakantam and Sitaraman, *Curr. Sci.*, 1945, **14**, 320.

EFFECTIVE NUMBER OF GENES

THE effective number of genes responsible for the inheritance of a quantitative character have been estimated on the assumption that the effect of each effective gene is equal in magnitude. Making use of a much weaker assumption of symmetry of the distribution of their dominance effect (h_a), we get the required number of genes as

$$k = \frac{3}{2} \frac{BH}{G} \left(1 - \left[1 \pm \frac{8BG}{9H^2} \right]^{\frac{1}{2}} \right),$$

where k is the required number; B denotes total dominance ($S[h_a]$); H denotes the unfixable variance ($S[h_a^2]$); and G denotes ($S[h_a]$).

By this formula we can only estimate the number of genes-governing characters which show dominance, but this makes no assumption regarding the distribution of the magnitude of their effects.

We further get $D - \frac{A}{k}$ as the variance of the magnitude of the effect of the genes. Here D represents fixable variance ($S[d_a^2]$); and A the difference of one parent from the mid-parent value—($S[d_a]$).

We also get covariance between the effect and the dominance effect of the genes as $\frac{(kF - BD)}{2A}$, where $F = S[d_a^2 h_a]$.

This quantity has a great potentiality of furthering our knowledge regarding the nature of dominance.

Details will be published elsewhere.

356-E, Govt. Quarters, P. N. MATHUR.
Karol Bagh, Delhi-5,
July 25, 1950.

A NEW BACTERIAL LEAF-SPOT AND STEM CANKER OF PIGEON PEA

A new bacterial leaf-spot was first noticed on lower leaves of pigeon pea (*Cajanus cajan* Millsp.) at Jalgaon and Anand in September,

1949. Under ideal conditions, the pathogen produces small, (0.5 mm.), round, water-soaked spots on the leaves after an incubation period of 7 days. The spots as they develop become quadrilateral (1 mm.) and are surrounded by a halo on the upper surface of leaves. Spots which are light-brown initially become dark-brown later and are raised on the upper surface as a result of drying of bacterial exudation. The spots when coalescent form large lesions (2 mm.). In severe cases of infection, spots are found all over the leaf; the infection which extends along the main and lateral veins of the leaf, leaf-edges and the leaf-petioles results in general yellowing and ultimate shedding. On the main stem and side branches, the pathogen produces dark-brown cankers which when numerous and close cause peeling of the bark.

Xanthomonas cajan Sp. nov.

Short rods, gram-negative, capsulated, not acid-fast, motile by a single polar flagellum, stains readily with common dyes and measures $1.3-2.2 \times 0.9-1.4 \mu$. On potato dextrose agar plates, colonies are smooth, shining, with entire margins, pulvinate, colour naphthalene yellow (R), diam. 1.5 cm. after 7 days; on nutrient agar plates, colonies are round, shining, slightly raised, colour baryta yellow (R), dia. 7 mm. after 4 days; milk peptonised; litmus reduced; gelatin liquefied; casein digested; starch hydrolysed; produces acid but no gas in dextrose, lactose and sucrose; salicin not utilised; ammonia and hydrogen sulphide produced; nitrates not reduced; M.R. and V.P. tests negative; sodium chloride tolerant upto 3%; non-lipolytic; Loeffler's solidified blood serum liquefied in 10 days; no growth in synthetic asparagin medium; fair growth in Koser's liquid and solid citrate media; optimum temperature 30°C., thermal death point 51°C.

Pathogenic to *Cajanus cajan* Millsp. Full account will be published elsewhere.

Plant Path. Lab., Y. S. KULKARNI.
Agric. Coll., Poona, M. K. PATEL.
July 30, 1950. S. G. ABHYANKAR.

CHROMOSOME NUMBERS IN GENISTEAE

THE note records the chromosome numbers in *Heylandia latebrosa*, *Rothia trifoliata* and a few species of *Crotalaria* belonging to the tribe Genistee (S. F. Papilionatæ).

A study of the chromosome numbers from PMC of *Crotalaria biflora*, *C. bifaria*, *C. hirta* and *C. striata* var. *acutifolia* has revealed $n = 8$. This is in conformity with the previous reports

for the other species.^{1,2} The counts from the root-tip cells of *C. biflora*, *C. medicaginea* var. *neglecta*, *C. striata* var. *acutifolia*, *C. anagyroides* and *C. usaramonsis* showed $2n = 16$ thereby confirming the remarkable uniformity of the haploid number 8. The only exception, however, is *C. incana*, which is characterised by $n = 7$ and $2n = 14$.

Heylandia latebrosa and *Rothia trifoliata* resemble *Crotalaria* in having $n = 8$ and $n = 7$ respectively. The tribe Genistæ, therefore, has basic numbers 7 and 8 and it is a matter of interest to note that the intergeneric relationships in the tribe are based on aneuploidy.

The author is indebted to Prof. A. C. Joshi, D.Sc., for suggesting the problem and for guidance, to Dr. H. A. Sen, Ottawa (Canada), for seeds of *C. incana* and to the National Institute of Sciences of India for the award of a Junior Research Fellowship.

Govt. College,
Hoshiarpur,
October 5, 1950.

Y. SUNDAR RAO.

1. Darlington, C. D., and Janaki Ammal, E. K., *Chromosome Atlas of Cultivated Plants*, 1945. 2. Sundar Rao, Y., *Ind. Jour. Genet. Pl. Breed.*, 1943, 3, 64-66.

THE CHROMOSOME COUNTS OF *CITRUS SUNTARA*

*Citrus suntara** Hort. ex Tanaka, commonly known in the Central Provinces (Madhya Pradesh) as Nagpur santra is a very important commercial loose-skinned orange of India.¹ The chromosome counts of this cultivated fruit-tree does not appear to have been made so far.² It flowers twice a year; during February (*ambé-bahar* flowering) and June (*mrig-bahar* flowering).

A cytological study was, therefore, made in 1942³ of the different species of *Citrus* with particular reference to *Citrus suntara*. A number of metaphase plates during microsporogenesis was examined, counted and later confirmed. The counts have been found to be consistently $n = 9$ (Figs. 1 and 2). Thus

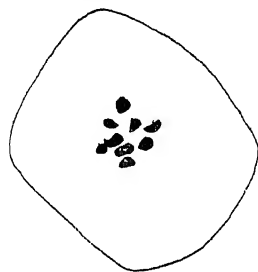


FIG. 1

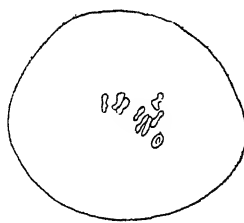


FIG. 2

FIG. 1. Shows the polar view of the metaphase stage; and FIG. 2. The equatorial view of the same. Magnification $\times 1350$.

this species too, naturally falls in line with other species of *Citrus* already recorded.²

Horticult. Res. Institute, T. C. N. SINGH.
Nagpur-Ajni, Miss R. SHAH.
December 25, 1948.

* *Index Kewensis—Supplementum*, 1926-30, 8, p. 53.

1. The cultivation of this special loose-skinned Nagpur Orange is very restricted, confined only to the district of Nagpur. 2. Darlington, C. D., and Janaki Ammal, E. K., *Chromosome Atlas of Cultivated Plants*, (George Allen & Unwin Ltd., London), 1945, pp. 190-91.
3. At the Horticultural Research Institute, Nagpur-Ajni.

ANOTHER STRAIN OF *PHYSALOSPORA TUCUMANENSIS*

THREE types (A, B and C) of *Colletotricum falcatum* Went (*Physalospora tucumanensis*) were described earlier¹; the light type B was reported to be more virulent than the old dark type A. Type B, because of its association with the epidemic of 1939-40 and 1940-41 and high virulence, was used for susceptibility tests carried out locally and in the co-ordinated tests. The varietal gradations arrived at in subsequent years were based on the tests carried out with type B. Varieties like Co. 508 which were found to be susceptible in the tests were subsequently proved to be such under natural conditions and varieties like Co. 453 and Co. 513 which were found to be comparatively resistant (or less susceptible) continued to be such till the beginning of the 1949-50 season.

Co. 453, which covered a high percentage of cane acreage in North Bihar, was found to be heavily infected with the red rot disease in Champaran and parts of Muzaffarpur and Darbhanga districts. The incidence of the disease on the clump basis varied from stray cases to as high a percentage as 75%. Samples from different localities were collected, cultured and inoculated on standing canes.

A few new types of *Physalospora tucumanensis* strains were recognised in cultures, the prominent among which are designated as types D, E, F, G and H. The cultural characters are described below:

1. *Type D*.—The texture of colony is loose. The aerial mycelium is sparse and translucent during the first week. The slimy masses of conidia are abundant covering 50 per cent. or more of the surface of the medium. In conical flasks and petri-dishes the concentric depressions are full of conidia. The number of acervuli on the rind is more than in other types.
2. *Type E*.—The aerial mycelium is of velvety texture and profuse with scanty

production of conidia. Slimy masses of conidia are sparsely distributed covering about 25 per cent. of medium.

3. *Type F*.—It forms cottony growth of mycelium which turns grey with age. The conidial masses which are dark grey at first change into pink masses.

4. *Type G*.—The aerial mycelium is dark grey and profuse. Slimy masses of conidia are sparse.

5. *Type H*.—The colony is loose and silky, aerial mycelium during first two weeks almost translucent with abundant dark pseudopycnidial masses; slimy masses of conidia on the surface of the medium.

The behaviour of Co. 453 when tested with 'Type D' is quite different. The average length of infection (the spread of the parasite in the standing canes) is 27.7" and the longest recorded is 106" which exceeds the previous records of Co. 210, Co. 213 and Co. 299 with 'Type B' by a few inches.

The linear spread of infection in 30 days after inoculation is noted in Table I.

Sl. No.	Type	Linear spread of infection in inches	No of internodes infected
1	D	27.7	5.4
2	E	17.9	3.6
3	F	12.0	3.0
4	G	11.3	2.3
5	H	11.8	2.5

Of the five isolates the 'Type D' is the most virulent and is a new strain; F, G and H are closely allied to 'Type B', while E appears to be an intermediate form.

The results of the susceptibility tests measured by linear spread of infection in 30 days after inoculation, are given in Table II for a few varieties with 'Type D'.

The varieties are graded into four main classes according to the linear spread of infection in cane tissues.

CLASS I.—Resistant—The infection is confined

TABLE II
Varietal susceptibility tests

Sl. No.	Variety	Linear spread of infection in inches with 'Type D'	No. of internodes infected	Linear spread of infection in inches with 'Type B'
1	B.O. 3	22.1	5.1	4.6
2	B.O. 10	7.4	1.9	4.1
3	B.O. 11	6.9	1.7	4.6
4	B.O. 15	4.1	1.3	6.6
5	B.O. 17	8.9	2.0	4.6
6	B.O. 24	22.9	4.8	7.7
7	Co. 299	30.1	6.1	36.9
8	Co. 313	15.4	3.9	10.8
9	Co. 331	34.4	12.5	20.9
10	Co. 333	16.8	5.7	5.9
11	Co. 453	27.7	5.4	4.6
12	Co. 513	13.6	2.9	13.5
13	Co. 557	38.3	8.5	29.4
14	CoK 29	15.2	4.0	10.4
15	CoK 32	16.8	4.3	11.0

to the internode inoculated—linear spread 6" and less B.O. 15.

CLASS II.—Less susceptible—The infection is confined to the internode inoculated and the adjacent internodes—linear spread of infection 6" to 12". B.O. 17, B.O. 10, B.O. 25 and B.O. 11.

CLASS III.—Susceptible—The infection is confined to 5 or 6 internodes—linear spread 12" to 20". Co. 313, CoK 30, CoK 29, Co. 313, Co. 513 and B.O. 27.

CLASS IV.—Highly susceptible—linear spread of infection exceeds 20". Co. 557, Co. 331, Co. 299, Co. 453, Co. 622, B.O. 24 and B.O. 3.

The conditions that favour variations in the parasite are under investigation.

Central Sugarcane Research S. A. RAFAY.
Station, Pusa, Bihar,
September 20, 1950.

1. Rafay, S. A. and Padmanabhan, S. V., *Curr. Sci.*, 1941, 10, 1, 25-26.

SYMPOSIUM ON RECENT ADVANCES IN BIOCHEMICAL TECHNIQUE

UNDER the joint auspices of the Society of Fermentation Technologists, India, the Society of Pharmacology and Experimental Medicine and the Association of Food Technologists, a SYMPOSIUM ON RECENT ADVANCES IN BIOCHEMICAL TECHNIQUE will be held in the premises of the Indian Institute of Science during the impending Science Congress week. The symposium will include a discussion of subjects pertaining to the application of radioactive and heavy isotopes in the study of intermediary metabolism, chromatographic analysis,

physico-chemical methods, spectrophotometry, microbiological and biological assays.

Dr. A. Srinivasan, Dr. P. R. Venkataraman, Bombay, Dr. P. S. Sharma, Madras, Dr. V. N. Patwardhan, Coonoor, Dr. N. N. De, Dr. S. S. De and Mr. V. S. Govindarajan, Bangalore, are expected to participate in the proceedings of the symposium.

The symposium will be followed by a demonstration of the equipment employed in such studies. A detailed programme of the symposium will be issued in due course.

REVIEWS

Analytic Geometry. By R. D. Douglass and S. D. Zeldin. (McGraw-Hill Book Co., Inc.), 1950. Pp. ix + 216. Price \$2.75.

This book is specially written for the class of students who have had no systematic training in analytic geometry and who would make a rapid study of the subject before taking up a course in calculus. The main topics treated in the book are the conics and conicoids. In the study of the conics it is interesting to find that the ellipse and the hyperbola come immediately after the circle and that the parabola comes last. The concept of the directrix is used in the case of the parabola but not for the ellipse and the hyperbola. Some standard curves are traced and the use of polar co-ordinates and parametric representation in the study of curves is illustrated. There is a good collection of exercises answers to which are provided at the end. The printing and get-up of the book are excellent. The graphs and the tables are welcome additions to the lucid explanations of the text. One wishes the book were a little bigger and packed with more information about curves and surfaces.

V. V. N.

Advances in Colloid Science, Vol. III. Edited by H. Mark and E. J. W. Verwey (Interscience Publishers, Inc., New York), 1950. Pp. xi + 384. Price \$7.50.

This volume contains articles from eminent experts on the following subjects: (1) Atomic Forces and Adsorption; (2) Surface Chemistry and Colloids; (3) Quantitative Interpretation of the Electrophoretic Velocity of Colloids; (4) Lyogels; (5) Ultracentrifugal Sedimentation of Polymolecular Substances; (6) Fatigue Phenomena in High Polymers; and (7) Flotation.

In the first article we have an interesting discussion on the nature of non-polar and polar van der Waals' forces and the collaboration of the various attraction forces in adsorption of single atoms and molecules. The order of magnitude of such adsorption energy is 10 Kcal/mole. When, however, an ion is adsorbed on an ionic or metal surface, coulomb and induction forces come into play and adsorption energy may increase to 50 Kcal./mole, as in the case of a single cesium ion on a tungsten metal surface. One wishes that more space had been devoted to the treatment of multi-molecular

adsorption layers with special reference to the work of Brunauer, Emmet and Teller.

In Article 3, an interesting section deals with Henry's attempt to solve the contradiction between the theories of (1) Smoluchowski, which is based on the assumption that a charged particle is non-conducting and has a surface which is large compared to the extension of the double layer, and (2) of Huckel, who extended the theory of conductance of ions to that of charged colloidal particles.

In Article 5, the use of the ultra-centrifuge to study of high polymers with special reference to the sedimentation properties of thread-like molecules has been discussed. Many of the unexplained facts regarding the dependence of sedimentation velocity on concentration and the effects of polymolecularity have been brought to light and problems awaiting solution have been suggested.

In Article 6, the possibility of developing a general law of fatigue for rubbers in respect to the dependence of fatigue life upon the minimum dynamic strain has been discussed and the bearing of this type of work on examination of non-rubber polymers has been indicated.

The seventh chapter on Flotation gives a very readable account of the up-to-date work on this subject of great technical importance. The technique has developed so far that it is now possible even to separate solid particles of sylvite (KCl) from solid particles of halite (NaCl).

The book is a storehouse of information which will be very useful to investigators who are interested in these special branches of colloid chemistry.

J. C. G.

Physical Methods in Chemical Analysis, Vol. I. Edited by W. G. Berl. (Academic Press, Inc., Publishers, New York), 1950. Pp. xiii + 664. Price \$12.00.

Notable advances have been made in recent years in the development of techniques for the chemical analysis of substances. Of particularly great interest and service are those methods of quantitative analysis which have to be resorted to in cases where the substance to be analysed is available only in merest traces, which may not also be destroyed during analysis; or consists of a mixture of closely related chemical

compounds which do not admit of being easily separated by simple physical or chemical means. For such analyses, analytical tools of extreme delicacy based on physical principles have been evolved, and the use of these is the job of the specialist. An analyst of today, if he is to be in a position to use these tools, must be well grounded in the basic principles of the different physical methods that have come into vogue. It is for the understanding of these basic principles that the book under review is intended. Indeed, the editor and publishers of this volume have to be congratulated on having been able to obtain contributions from reputed authorities on each subject. The title of each chapter with the name of the contributor is given below:

Absorption Phenomena in X-rays and γ -rays (16 pp.), Clarke; X-ray Diffraction Methods as applied to Powders and Metals (88 pp.), Davidson; X-ray Diffraction as applied to Fibres (70 pp.), Howson; Electron Diffraction (26 pp.), Brockway; Spectro-photometry and Colorimetry (61 pp.), Brode; Emission Spectrography (77 pp.), Shermann; Infra-red Spectroscopy (71 pp.), Nielson and Oetjen; Raman Spectra (17 pp.), Hibben; Polariscopic Methods (53 pp.), West; Refractive Index Measurement (46 pp.), Tilton and Taylor; Electron Microscopy (49 pp.), Heidenreich; Mass Spectrometry (51 pp.), Washburn.

This book is by no means a handbook of chemical analysis, but provides the highly necessary introduction to the various methods of analysis. The theoretical basis of each method is given briefly, (sometimes perhaps a little too briefly) at the beginning of each chapter. The methods of handling the most modern types of apparatus are described and their broad fields of application also dealt with in sufficient detail. In a book of this type, it would be unfair to expect a large amount of experimental detail for the practical worker in any particular field. Even in this respect, some of the articles, especially those on X-ray analysis, spectro-photometry and refractometry are fairly comprehensive. Each chapter contains an extensive bibliography which would be invaluable to the practical analyst.

An example of the stupendous power of some of the new methods dealt with would perhaps be not out of place here. X-ray absorption techniques have made it possible today to estimate quantitatively (without destroying the specimen) the amount of phosphorus, calcium, oxygen and nitrogen in tissues only 2μ thick and area $10\mu \times 10\mu$; the actual weights

of substances involved being of the order 10 to 10^{-12} gm.!

The book conforms to the high standard usually associated with most American scientific publications and contains very few misprints. [The only two which the reviewer came across were, "crystallite" to be read as "crystal line" (page 30, line 18) and the wrong caption to figure 7 on page 549.] The reviewer warmly recommends this book to all those who are interested in the recent advances made in physical methods of chemical analysis.

S. RAMASESHAN.

Soils, Their Physics and Chemistry. By A. N. Puri. (Reinhold Publishing Corporation, New York), 1949. Pp. xiv + 550. Price \$7.00.

This book is a valuable contribution to the subject of Pedology or Soil Science which, according to the author, may now be considered to have attained the status of an independent branch of human knowledge. The book embodies mainly the author's own researches on soils over a period of nearly twenty-five years.

The book is divided into three parts: Chemistry of the Soil, Mechanical Analysis of Soils and Soil Moisture. There are 242 tables and 182 figures and graphs embodying the author's own data on which his conclusions are based. The author has endeavoured to show that the bewildering lack of coherence in the mass of accumulated data on soils is only apparent, but that, when studied without prejudice, the data are capable of being reduced to simple generalisations as with other sciences.

In the first part, the soil is conceived as being made up of a framework of hydrated ferro-alumino-silicates whose suspension in water behaves like any other weak acid. It decomposes carbonates and sulphides, neutralises alkali, hydrolyses esters and inverts sucrose. Natural soils are merely mixtures of saloids of this soil acidoid. Starting with these elementary concepts, the author has very successfully explained the complicated phenomena associated with soils in the simple language of acidimetry and alkalimetry.

In the second part on Mechanical Analysis, data are presented to show that maximum dispersion of particles is attained when the soil is converted into a Na-saloid at pH 10.8. The active mass per unit volume as calculated from these primary particles agrees fairly well with that obtained by chemical means.

In the last part on Soil Moisture, the author expounds the theory that all soil moisture is capillary moisture and its distribution and

movement can be explained by the phenomena of surface tension. With this basic assumption, the author calculates from the size distribution of the capillaries and the solid geometry of particles, the complete mechanical analysis of a soil and verifies it by direct determination.

A few apparatus devised by the author and some methods of analysis developed by him are also described. There are few references and there is no bibliography, not even of the author's own papers. No attempt is made to review any of the existing theories regarding the various soil phenomena as the author believes that they may confuse the novice for whom the book is written.

It is the first authoritative text-book on soils written by an Indian and abounds in data on Indian Soils. Readers in this country will, therefore, feel quite at home while going through this book.

N. N. N.

CHEMOTHERAPY OF TUBERCULOSIS*

The proceedings record the results of an investigation conducted under the auspices of the Medical Research Council of Ireland.

Having noted the inhibitory effect of the soluble diploicin derivatives on the growth of tubercle bacilli *in vitro*, in fairly high dilutions, the authors have tried to produce a number of derivatives of diploicin of high biological activity and suitable for parenteral administration to experimental animals. Mode of synthesis of a number of these compounds is described in No. 7, but none of these compounds exhibited antitubercular properties.

No. 8 of the proceedings gives some idea of the antitubercular properties of a number of diphenyl ether derivatives. To this class belong many substances of well known antitubercular power *in vitro*, like the 4 : 4'-diamino-diphenyl sulphone and its derivatives. They have found high biological activity in those amino-diphenyl ether derivatives in which the NH₂ group occupies the position para- to the oxygen bridge and that the activity is comparatively low in the ortho-amino compounds; while in halogenated diphenyl methane derivatives containing a phenolic hydroxyl substituent, high activity has been found to be associated with molecules in which the hydroxyl group occupies the ortho- or para-position to the methylene bridge. No

definite relationship could be deduced between the hydrophylic or the hydrophobic character of the linkage and activity. Final conclusions as to the relationship existing, in these related series, between constitution and antitubercular activity is not yet possible.

M. SIRSI.

Daily Fish Supply in S.-E. Asia Below People's Needs. *F.A.O. Bulletin*, Vol. V, No. 2, July 1950.

The July Number of the *F.A.O. Bulletin* contains a scientific medley of information useful to the peoples of South-East Asia in general, and of India in particular. It includes, amongst others, facts relating to fish supply, hybrid rice breeding, weed control by growth-regulating substances, control of foot and mouth disease of cattle, improvement of livestock under tropical and sub-tropical conditions, standardisation of timber classification, and the issue by the F.A.O. of the new bi-monthly booklet entitled *World Fisheries Abstracts*. In a short review, it is possible only to refer to topics of urgent interest in this country, namely, rice and fish production.

The present production level of fish in South-East Asia meets only a third of the normal protein food needs of its teeming millions, and the F.A.O.-sponsored Indo-Pacific Fisheries Council has therefore before it a programme of increase in size and quality of the fish-catch and of the bettering of the living conditions of the people engaged in fishing. This programme will include, (1) introduction of new methods and equipment; (2) collection of scientific information concerning the resources; (3) standardisation of measurements and techniques used in scientific investigation and (4) study of fish culture with special emphasis on the effect of transplanting species from one area to another.

The *World Fisheries Abstracts* is printed in such a way that a card index can be prepared out of a file of Abstracts and is designed to provide to the investigating fisheries specialists a key to the great volume of important technical material being published in their field, which in due course will serve as an encyclopaedia which can be constantly kept up to date.

The hybrid rice breeding programme is part of a large and comprehensive project for South-East Asia initiated about a year ago by the International Rice Commission, and involves crossing varieties of India and Japonica groups of rice at the Central Rice Research Institute of the Government of India at Cuttack, Orissa State, to secure varieties which will combine the

**Proceedings of the Royal Irish Academy*, Vol. LIII, Section B, Nos. 7-8, Vincent C. Barry and Dermot Twomey.

best qualities of each group. After the seed from the crosses is harvested, it will be sent for testing to the countries from which parent stocks were received. One of the advantages of hybridization is that through selection and crossing a variety may be produced which meets the particular needs of a certain region. Low rice yields in South-East Asia countries appear to be due to a variety of causes, *e.g.*, (1) poor fertility conditions under which rice is grown; (2) limitation of varieties used for planting; (3) susceptibility to plant diseases and to attacks by insects, and it has been estimated by F.A.O. experts that in South-East Asia countries yields of rice may be expected to increase fifty per cent. by the use of good seed varieties alone.

H. SRINIVASA RAO.

Introduction to Electricity and Optics. By N. H. Frank, Professor of Physics, Massachusetts Institute of Technology. Second Edition. (McGraw-Hill Book Co.), 1950. Pp. xi + 440. Price \$5.

In this book emphasis is throughout laid on the theoretical side and as such the logical mathematical presentation gets proper scope though no knowledge of advanced mathematics is called for. The presentation is clear and sufficiently detailed and is very adequate for any one desiring to appreciate the full signi-

ficance of the theoretical structure without great effort. The author wishes to consider the book as an elementary text.

The book is divided into two parts. All the four electromagnetic vectors, E , D , B and H of Maxwell's equations are introduced from the very outset in a general form, retaining their validity both for empty space and in the presence of material bodies. The second half encompasses the electric and magnetic properties of matter and is based essentially on the electromagnetic waves in dielectrics, thus smoothly leading to the subject of optics. Physical optics is well emphasized.

The newer system of units, metre, kilogram, second is introduced from the beginning along with the electrostatic and electromagnetic units and the advantages of the M.K.S. system are well brought out. The student is also made familiar with the older Gaussian units without which his understanding of much of the literature would be seriously handicapped. In the present edition, the M.K.S. has been further modified by rationalizing, *i.e.*, by getting rid of the factor 4π . There are altogether 20 chapters. Dispersion and Scattering, Interference, Diffraction and Heat Radiation are dealt with in the last 100 pages of the book. Needless to emphasize that the get-up and binding are excellent.

B. DASANNACHARYA.

INTERNATIONAL CONGRESS OF MATHEMATICIANS

THE Congress was held at Harvard University, Massachusetts, U.S.A., from 30th August to 6th September, 1950, under the presidency of Prof. O. Veblen. About 2,500 delegates from forty-six countries attended it. Six delegates from India took active part in the Conference, and read papers in various sections. They were B. R. Seth, R. C. Bose, S. N. Roy, S. D. Chawla, K. Chandrasekhar and S. Minakshisundaram. (Dr. S. S. Pillai, who was on his way to the Conference met with a tragic death in the T.W.A. air crash near Cairo.)

The two field medals, awarded at each Congress for outstanding research work, were received by L. Schwartz and O. Selberg. Prof. Hadamard was nominated as Honorary President of the Congress.

About four hundred papers were read in the various sections.

Addresses on special topics included the following:—

H. Hopf—Die n -dimensionale sphären und projektiven Räume in der Topologie. H. Cartan—Sur les fonctions analytiques des variables complexes. R. L. Wilder—The cultural basis of Mathematics. S. Bochner—Laplace operator on manifolds. A. Well—Number theory and Algebraic Geometry. A. Wald—Basic ideas of a general theory of statistical values. H. Davenport—Recent work in the geometry of Numbers. There were also special conferences on Algebra, Analysis, Applied Mathematics and Topology.

SCIENCE NOTES AND NEWS

1851 Exhibition Scholarship

The Royal Commissioners for the London Exhibition of 1851 will award in 1951 one science research scholarship to students from Indian Universities or Institutions having post-graduate Departments of Science. The value of the scholarship is £350 per annum and it is tenable for a period of two years to enable the selected student who has already completed a full University course and whose record gives evidence of capacity for original scientific investigation to devote himself or herself to post-graduate research in some branch of Pure or Applied Science at any Institution abroad approved by the Commissioners.

Subjects of the Indian Union below the age of 26 on May 1, 1951 are eligible for this scholarship. Applications from students whether residing in India or abroad have to be recommended by the authorities of a University or an Institution who should forward them so as to reach the Secretary, Ministry of Education, Government of India, New Delhi, not later than January 22, 1951.

Full particulars about the scholarship and the prescribed application forms can be obtained from the Registrars of the different Indian Universities or from the Ministry of Education (Section S-3), Government of India, New Delhi.

Turkish Scholarship for Indian Students

The Government of Turkey have offered one scholarship to an Indian student for study at a University in Turkey for a period of two years commencing from early next year. The value of this scholarship is TL 117.60 per month (equivalent to Rs. 200), besides exemption from payment of tuition and examination fees. The selected scholar will have to bear the passage charges both ways and also provide for his incidental and other expenses including medical charges, travel, etc.

The subjects which a student from India can take are Turkish, Language, Literature, History and Philosophy. Full particulars about the scholarship and prescribed forms of application can be obtained from the University concerned or the Central Ministry of Education.

Teterboro School of Aeronautics

In June 1950 the Teterboro School of Aeronautics, New Jersey, U.S.A., offered to the Indian students four scholarships in Aeronautics. The awards have been made to Messrs. Krishna Dev Merwaha, T. S. Srivastava, K. P. Dadlani and N. N. Batra. No more applications on this account will be entertained either by the Government of India or by the Teterboro School.

Dr. B. R. Seth

During his recent stay in the U.S.A. as Visiting Professor of Mathematics, Dr. B. R. Seth delivered a course of lectures on Elasticity, Hydrodynamics and Aerodynamics. He also participated in the Symposium arranged by the American Mathematical Society in the University of Michigan, being one of the principal speakers. He represented the University of Delhi and the Calcutta Mathematical Society at the International Conference of Mathematicians held at Cambridge, Massachusetts and took an active part in the International Conference on Fluid Mechanics which preceded it.

Industrial Research Laboratory, Devlali

An Industrial Research Laboratory is being established on a semi-commercial basis at Devlali, near Bombay, under the Directorship of Mr. N. P. Gandhi, formerly Professor and Head of the Department of Mining and Metallurgy at the Banaras Hindu University. The laboratory is to have equipment for chemical analysis, metallography, pyrometry, heat treatment and mechanical testing of metals and alloys (both ferrous and non-ferrous) testing fuels, furnaces and refractory materials, examining minerals, rocks, ores, waters, etc., and is intended to be a self-supporting Institution. The profits would be utilised for meeting the cost of research work which may be undertaken free-of-charge and for expanding the scope of its activities.

Award of Research Degrees

On the recommendation of Boards of Examiners consisting of Sir S. S. Bhatnagar, F.R.S., Prof. J. W. Smith, F.R.S. and Prof. S. S. Joshi; and Prof. H. S. Taylor, F.R.S., Prof. H. W. Melville, F.R.S. and Prof. J. W. McBain, F.R.S.,

the Banaras Hindu University conferred the D.Sc. degree on A. Joga Rao for his thesis on " H_2 , O_2 , Reaction under Electrical Discharge and Electro-Chemistry", and the Ph.D. degree on H. J. Arnikaar for his thesis on "Study of Joshi Effect and Corona Pressure Phenomena".

University of Travancore

Dr. P. V. Nair, Professor of Applied Chemistry, has been appointed Director of Research in the University of Travancore in the place of Dr. C. C. John who has accepted service under the Ceylon Government.

Photostat Service Unit at Kasauli

The Indian Council of Medical Research have microfilm service units at the Central Research Institute, Kasauli, and at the Tata Memorial Hospital, Bombay. The microfilm service has now been augmented by the setting up of a Photostat Service Unit at Kasauli.

Requisitions for photostat copies could be marked "PHOTOSTAT SERVICE" in block letters, to avoid any confusion with requests for microfilming work, and addressed to: The Officer-in-Charge, I.C.M.R. Microfilm Service Unit, Central Research Institute, Kasauli.

Symposium on the Origin and Distribution of Cultivated Plants in S.-E. Asia

The Indian Society of Genetics and Plant Breeding, with the co-operation and assistance of the UNESCO South Asia Science Co-operation Office, is organising a Symposium on the Origin and Distribution of Cultivated Plants in the regions of South Asia. Tentative dates fixed for the Symposium are January 12-15, 1951, and the session will be held in New Delhi. The Society has already invited the workers in the field in India and the neighbouring regions to contribute to the Symposium. The plants to be discussed will include cash crops, cereals, flowering plants, spices, etc. It is expected that Dr. A. Müntzing of Lund, Sweden, an authority on speciation and genetics of wheat and rye, Dr. S. C. Harland of Manchester, the world-renowned cotton geneticist and Dr. E. Anderson of Washington, whose work on the origin of maize is a fundamental contribution, will take part in the Symposium. Dr. Müntzing is one of the invitees of the Indian Science Congress Association and the UNESCO South Asia

Science Co-operation Office is arranging for the visit of the latter two scientists. From Pakistan Dr. Afzal (cotton), from Ceylon Dr. Chandraratna (rice and banana), from Malaya Prof. Holtum (orchids and spices), have so far agreed to participate.

The Symposium will be limited to the actual contributors, but observers from learned bodies and research institutions will also be invited to attend. Enquiries may be addressed to Dr. N. Parthasarathy, Secretary, Indian Society of Genetics and Plant Breeding, C/o Division of Botany, Indian Agricultural Research Institute, New Delhi 5.

Geological Survey of India

The latest number of the Records of the Geological Survey of India (Vol. 82, Part 1) gives a general report of the work done by the Survey during the year 1948. For purposes of intensive Survey work, India after the partition, has been divided into five circles each under the direction of a Superintending Geologist. The report under review gives a detailed account of the work done in each of the circles; in addition there are also elaborate accounts of work done under Mineral Investigations, Special Investigations including Geophysical Prospecting, Engineering Geology and Ground Water Investigations, etc. The report gives a good idea of the variety and volume of the work done by the Officers of the Survey. A coloured Geological Map of India indicating the field investigations carried out during 1947-48, adds greatly to the value of the report.

Forthcoming International and National Scientific Conferences in South Asia

Date	Subject of Conference	Location
1951	International Association for Hydraulic Structures Research.	New Delhi
Jan. 3-10		
Jan. 10-15	Sectional Meeting of the World Power Conference	Do.
Do.	International Commission on Irrigation and Canals	Do.
Jan. 28- Feb. 2	Indian Institution of Engineers—Annual Meeting	Bangalore

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